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Engineers Discuss New Problems At Their Annual Meeting

More than thirty papers presented in four days at technical sessions. Exhibition of automotive equipment an interesting feature

by Don Blanchard
Editor, Automotive Industries

A NEW high attendance record appeared certain as the Detroit annual meeting of the Society of Automotive Engineers passed the half-way mark on Tuesday of this week. Technical sessions so far have been of a high order, and have been supplemented by an interesting exhibition of automotive equipment.

One of the high spots of the technical sessions was a motion picture of injection and combustion in a compression ignition engine. The individual pictures making up this film were taken at the rate of 2000 per second, and they showed clearly what transpires inside the combustion chamber during the fraction of a revolution it takes the fuel to burn. The film was exhibited and discussed by A. M. Rothrock of the N.A.C.A., whose paper is digested elsewhere in this issue.

Delmar G. "Barney" Roos, Studebaker chief engineer and president-elect of the S.A.E., whose administration began at the annual meeting

The Lysholm-Smith hydraulic torque converter, which provides a conversion ratio of five to one and, with adjustable pump blades of six and one-quarter to one, was described by J. C. Marble at the motorcoach and motortruck session. This converter is now being built in England by Leyland, and is being used experimentally in city bus service in Buffalo, N. Y.

Discussion following the paper presented by C. D. Peterson of Spicer on multi-range transmissions centered mostly around the question of whether or not the desired range of reduction ratios should be secured through an overdrive. Although no conclusion was reached, there was considerable opinion that the top speed should be direct except in certain services where the truck returns light.

Abstracts of the Papers Presented Appear on the Following Pages.

The student session on Monday evening drew about 800 for a demonstration of television presented by J. O. Perrine, of the American Telephone and Telegraph Co. With the assistance of a wealth of apparatus, Mr. Perrine took the audience behind the scenes in long-distance picture transmission, showing what has been accomplished and how, and then detailed the obstacles yet to be surmounted. Even though the subject was not automotive, this demonstration unquestionably was one of the outstanding features of the entire meeting.

At the Diesel session, F. M. Young, of Young Radiator Co., discussed recent developments in water and oil cooling devices, emphasizing the need for cooperation between engine and radiator manufacturer. Another feature of this session was a paper on starters for

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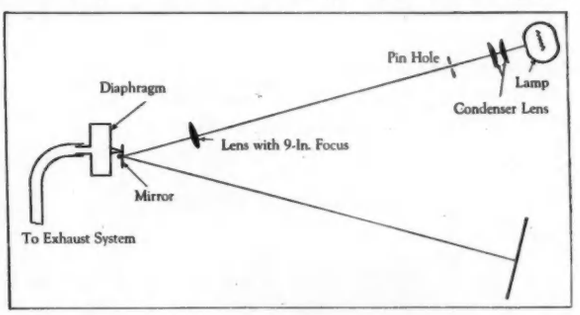
Hunt Causes of Noises in Exhaust System with New Manometer

E. G. Gunn discusses muffler noise and describes muffling device which provides vacuum for windshield wiper operation

A NEW manometer for tracing pressure waves in the exhaust system of internal combustion engines was described by E. G. Gunn in his paper on "Mufflers." Referring to Fig. 1, a small stressed diaphragm oscillates a tiny mirror. The image of a pinhole in front of a powerful light is reflected and focussed on a screen. The mirror is slightly tilted, so that the spot of light describes a circle on the screen, which forms the base circle of the polar diagram obtained. Deviations of the spot of light from this circle are a measure of the pressure acting on the diaphragm. A loosely mounted flywheel serves to keep the apparatus revolving uniformly. The manometer is driven at one half crankshaft speed and is connected by tubing to various points of the exhaust system. While the engine is running, the effect of changes in the system can be noted on the screen much more accurately than by ear. The instrument is used principally to observe pressure variations not exceeding 1000 per sec.; for high-pitch noises a Stewart filter, designed to let pass only sounds with a frequency of more than 625 cycles per second, is used with a stethoscope.

The first note of importance in an exhaust system is the fundamental (and overtones) of the exhaust pipe. In many cases observed, the lower critical period of exhaust notes on cars always occurs when the number of explosions per second agrees with the fundamental note of the exhaust pipe. The fundamental of most exhaust pipes is of the order of 60 per sec., while the note coming from the tail pipe is usually much higher and is composed of many frequencies.

Exhaust noises can be eliminated in mufflers by sound-wave absorption and sound-wave cancellation (interference). Mufflers which depend on sound absorption convert sound energy into heat. Examples are mufflers employing tubes or partitions with fine holes through which the exhaust gases must pass, and mufflers filled with porous material which absorbs sound by damping the waves passing through it.



Diagrammatic illustration of low-pressure manograph for exhaust system (Fig. 1)

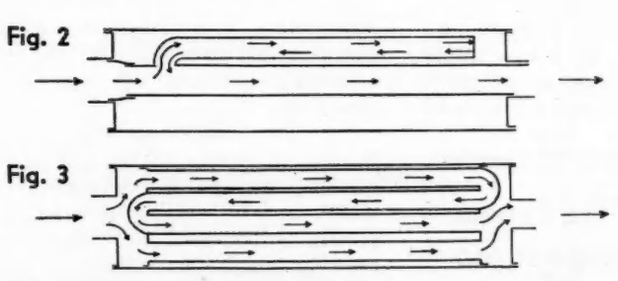
Mufflers which depend on wave interference are of three general types, as follows:

(a) Fig. 2. Those which incorporate Quincke tuners, i. e., a closed-end tube of a length equal to one quarter the wave length of the wave to be cancelled. The wave enters the tube, is reflected from the far end, and returns out of phase to completely or partially cancel.

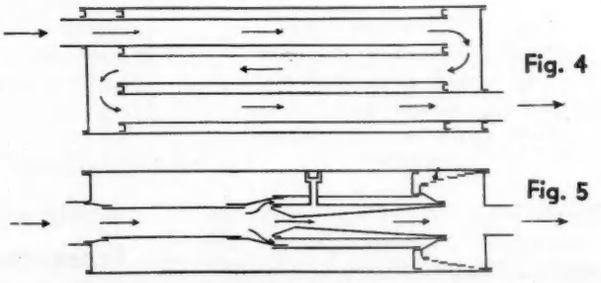
(b) Fig. 3. Those which incorporate Herschell tubes, i. e., a divided path for the sound waves, one path being one half of the wave length to be cancelled longer than the short path. The waves, on reuniting one half wave length out of phase, cancel.

(c) Fig. 4. Those in which the gas travels through perforated pipes, alternately from one end of the muffler to the other. These are usually made with three pipes, the gas first flowing from the front to the rear through one pipe, then through another pipe to the front, and then to the rear and into the tail pipe. At any transverse section of the muffler a wave in one pipe is out of phase with the wave in another pipe, can short circuit across the surrounding chamber and cancel.

Until recently mufflers were mounted rigidly on the frame, but as other parts of the car were silenced,



Mufflers embodying Quincke tuner (Fig. 2, above) and Herschell tubes (Fig. 3, below)



Three pipe type muffler (Fig. 4, above). Venturi muffler for vacuum power (Fig. 5, below)

noises due to muffler mounting began to be noticeable. To segregate mounting noises from other noises a "trailer" was developed. An observed noise which disappears when this trailer is being used is due to muffler mounting. One successful mounting consists in attaching the exhaust pipe to the rear end of the powerplant, letting the front end of the muffler hang on the exhaust pipe, and supporting its rear end in a bracket carried in soft rubber.

So-called shell noise, a high-pitch noise, which can be heard with the stethoscope, probably originates at the exhaust valve by the action of the exhaust gases passing at high velocity through the partly opened valve. Overhead-valve engines are considered the worst offenders as regards shell noise, but sometimes a muffler, which has no objectionable shell noise on one overhead-valve engine, has pronounced shell noise on another engine of the same type.

There has appeared lately, a muffler in which the passage of part of the exhaust gas through a venturi creates a lower than atmospheric pressure to be used for operating the windshield cleaner, horn, fuel system and possibly other things. It is easy to get upwards of 12 in. of mercury of vacuum. Fig. 5 shows one design. In this arrangement, the back pressure at the lower speeds increased over that of a through-type muffler, but not necessarily at high speeds. The higher back pressure at the lower speeds very materially helps silencing. As the speed increases, the resistance and velocity-head pressure on the valve moves it against the spring pressure to the right, by-passing part of the exhaust gas. By-passing part of the gas is done in much the same manner as in an air-valve carbureter.

Research Answers Intake Noise Problems

Almen and Wilson tell about GMR's work in the development of intake silencers

HOW the G.M.R. tackled the problem of engine noise, and the subsequent development of intake silencers resulting from the study were described in a paper contributed by J. O. Almen and E. E. Wilson.

Certain periodic noises were traced to engine vibration and lack of isolation of the engine from the frame. These were eliminated by reducing the frequency of vibration of the engine on its mountings to such a degree that it could come into resonance with power impulses only at car speeds below the regular driving speeds. This was accomplished by making the rubber mountings gradually softer.

In a preliminary study of intake noise it was found that the so-called power roar, which was objectionable in certain automobiles, is a case of resonance in the intake system having frequencies of 100-150 cycles per second. It was thought desirable to eliminate the noise at the source if possible. Tests showed that the inlet noise was a maximum within a relatively narrow range of engine speed at wide-open throttle, and that there was no difference in the dominant note whether the engine was running under its own power or was being "motored."

Further investigation showed that the dominant note could be obtained with the engine stationary by blowing a jet of air over the intake port while the intake valves were open, thus indicating that the noise originated in the resonance chamber formed by the cylinder and valve, which was excited by the flow of air through the valve at the time of initial valve opening. It should be noted that the frequency of this combination of valve opening and cylinder volume is not greatly changed with piston position, because of the coincident change in valve opening.

When the source of the noise had been found it was apparent that its elimination was out of the question, and the only possibility lay in developing a satisfactory type of silencer to be applied to the conventional carburetor and manifold. It was clear that a baffling arrangement would not do, because of its restrictive effects cutting down the engine output, and also because such a silencer ordinarily is quite ineffective with respect to low-frequency noises.

It was noted that in addition to the intake noise range of 35-45 m.p.h., there was another, higher range of car speed also accompanied by intake noise of different characteristics, so that at least two chambers were necessary.

Some of the higher harmonics of the firing frequency likewise are present and must be silenced, to insure a completely satisfactory job. Some of these higher frequencies may be silenced by means of chambers or by means of sound absorbing material. The amount of silencing of the higher-pitched noises will depend on the balance between desired degree of attenuation on the one hand and cost and space limitations on the other. Ordinarily, the most practical silencer consists of a combination of chambers and sound absorbing material. Sound absorbing material is used primarily to silence high-frequency noises, such as hisses, originating in the carburetor. Other low-pitched noises issuing from the intake are most satisfactorily silenced by the chamber-type silencers.

Paralleling the development of the intake silencer, a satisfactory exhaust silencer, also utilizing the principle of resonance silencing, was developed. One important result of these studies was a definite proof that a design problem is presented in silencing either the exhaust or intake which is as tangible as the design problem in a crankshaft, for example. Furthermore, the results to be expected from a given design can be predicted by paper analysis.

After the fundamental design problems had been worked out for the resonance type of intake silencer, the commercial design problems were worked out in cooperation with the AC Spark Plug Company and the Buick Motor Company.

It was pointed out by the authors that whereas the silencing requirements can be worked out on paper, the results obtained are vitiated if changes in engine design, such as a change in valve timing, are made subsequently. It is necessary in most cases that engine design be settled as regards displacement, valve timing, carburetor and manifold before a silencer can be satisfactorily designed. Another common experience is to attempt to build a silencer which is much too small for the volume of noise and range of frequencies to be suppressed.

Noise Absorptive Materials Give Better Relative Result in Lower-priced Cars

NOISE treatment in the automobile was the subject of a paper by Theodore M. Prudden of Pacific Mills. Mr. Prudden pointed out that the problem of noise reduction in closed cars involves two items, viz., insulation of the body against the entrance of noises from the outside, and absorption of such noises as may enter through open windows or any other openings in the wall of the body.

As to the advantages of quiet inside a car, the author made the claim that a properly quieted car can be driven more miles at a stretch without inducing fatigue, and that it can be driven faster without the occupants being sensitive of the additional speed.

It was further claimed that proper acoustic treatment tends to give a low-priced car the same sound as that of a heavier, high-priced car. The author explained this by saying that absorptive materials are much more effective in absorbing high-pitched noises—which may be expected in the low-priced car owing to its lighter members and less accurate mechanical fits—than low-pitched noises, which are generally associated more with the heavier construction of the higher-priced cars.

The effect from putting the same amount of noise-absorptive material in a high-priced car is often less than that of the same amount placed in a low-priced car. The reason is that the ear values a noise not only by its volume but also by its pitch, and a high-pitched noise is more objectionable than a low-pitched noise of equal volume.

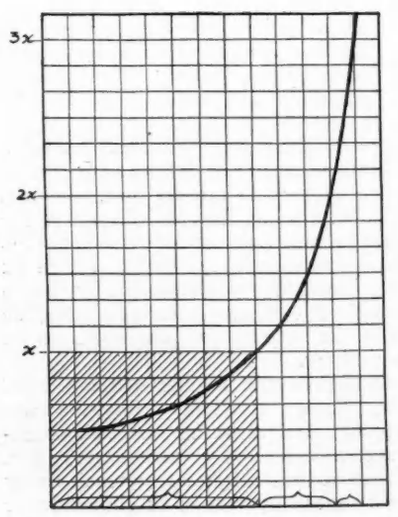
Acoustic material can be used to best advantage at parts of the body where it can be effective both as a noise insulator and a noise absorber, that is, on the dash and cowl, the roof and the floor. When placed behind the upholstery or behind the fiber panels on the inside of the doors, it is effective only as an insulator, and a less expensive material can be used to better advantage than one capable of serving both as an insulator and a sound absorbent.

Material put on the floor should have high absorption as well as high insulating value. To achieve high absorption in a floor material it is essential to have the floor covering of such a nature that noises inside the body can penetrate it and reach the absorption material underneath. This means that rubber mats, or carpets made with a rubber backing, must not be used. It is true that this is contrary to practice in low-priced cars at the present time, but a change in practice may be looked for in this respect.

Many cars of today use materials of high insulating value on the dash, but the rigidity of these materials prevents their use on the curved part of the cowl. In addition to the use of this insulating material, it is advisable to face the inside of the dash with sound-absorbing material, taking care to seal up the holes in the dash for wires, speedometer shaft, etc. Lining the cowl with absorptive material is common practice. Such lining material, however, should be a sound absorber as well as a sound insulator.

The kick pads on both sides of the cowl are often made of a fiber board faced with fabric. With such an arrangement, the absorptive material underneath is covered by the fiber board, which is not readily penetrable by sound. Of course, these kick pads are usually open at the top, so that sounds can pass behind the fiber board, but more effective noise absorption would be obtained if the centers of these kick pads were cut out in the shape of a board frame, over which the fabric is stretched.

Tests have shown that the cotton batting and burlap in the roof have considerable noise-absorptive properties, so that little is gained by adding extra absorptive material there. The curved metal surfaces at the edges of the roof, on the other hand, are ideal surfaces for noise treatment. They furnish a considerable area (from 8 to 15 sq. ft.), and they yield the full value of the material in heat- and sound-insulation, and in absorption. Moreover, any absorptive material placed here is more nearly at the level of the ear, and therefore especially effective.



Graph showing the increase in noise reduction with increase in area of acoustic material.

The vertical scale represents units of acoustic material and the horizontal scale percentage of noise reduction

One of the problems that arise is how far it is justifiable to go in noise insulation on economic grounds. Some light is thrown on this problem by the graph, which shows the relation of noise reduction to the amount of acoustic material used. Notice that the first x sq. ft. of material accomplish a great reduction in the noise, the second x sq. ft. less, and the reduction continues to be less for each additional unit.

Now, the first x sq. ft. may represent the absorptive materials already in an untreated car. Such materials are the upholstery, carpets, the cotton batting in the roof, etc., hence the first big reduction has already been achieved, and only lesser reductions can follow. It will readily be seen that the noise reduction due to a fourth or fifth unit of x sq. ft. is so small that it is hardly worth while. Between 2 x and 3x sq. ft. is about the economic limit. This chart, represents the reduction accomplished by a material having the absorption of 1½ in. of hair felt. A less efficient absorber would, of course, require a larger number of square feet to achieve the same results.

The biggest problem in noise tests is to reduce to a minimum all outside noises which can affect the noise level in the car. It is obvious that every car will seem to be quiet in very noisy traffic, because the noises within the car are masked by the greater outside sounds.

The greatest single obstacle to noise testing is wind. A side or quartering wind of only 20 m.p.h. can raise the noise level in the car as much as 10 decibels, or more than the reduction which can ordinarily be achieved by adequate noise treatment.

Tests should preferably be made in a wind of less than 10 m.p.h. If possible, the car should be driven directly into the wind. The road should be as nearly level as possible, so that there will be little variation in the power necessary. It should be dry, and should be free from snow and snow banks along the edge, because snow is a good absorber and reduces the noise level. Rain, of course, is bad, because the drumming of the rain drops increases the noise level in the car.

Other factors affecting the noises which should be eliminated, are openings in the hood, or the dash ventilator. the various settings in ride control mechanisms, and the pressure of the tires. The same number of observers should be kept in the car between different tests, because the clothing of occupants adds to the amount of absorptive materials.

Six Factors Make For Good Steering Performance

DETAILS of apparatus devised to assist in working out the correct steering geometry for any specific design were revealed in a paper, "Notes on Steering," by F. F. Chandler, vice-president, Rosse Gear and Tool Co. This apparatus, which is described herein, is used to determine the proper positions of the knuckle arm and steering arm balls.

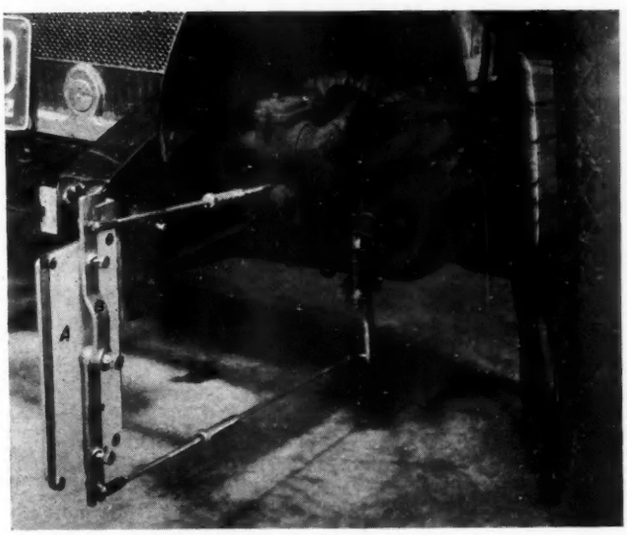


Fig. 1—Axle rod gage.

Steering performance depends on six items, viz., the proper size of steering gear, rigidity of action, accuracy of action, efficiency of action, ratio of reduction, and inherent design characteristics,

Steering-gear designers aim to secure higher efficiency and lower cost of production; these aims have been achieved in different degrees in the different gears on the market, but not even the best of these will give the best steering results unless the steering hook-up or front-end design is correct.

Two factors of paramount importance in front-end design are the knuckle-arm-ball position and the steering-arm-ball position. The knuckle-arm ball must be so located as to produce a minimum longitudinal motion of the drag link when front axle rotation is produced by road inequalities or brake application. At first glance it would seem that the knuckle-arm ball should be on the transverse axis around which front axle rotation takes place, but ordinarily this is not the case. Where there is a rubber shackle or a kick shackle, a certain backward displacement results when the wheel hits a road obstruction. This adds to or subtracts from the ball movement, depending on whether the ball is below or above the axis of axle rotation.

It is therefore desirable to have the ball above the true axis of axle rotation, so that since the stationary position of the drag link has the effect of pushing the ball forward with relation to the axle, the ball will roll forward the same amount, thereby preventing deflection of the wheels. Most jobs are not much affected by slight alterations in the position of the steering-knuckle ball; it is advisable to start with a position for the ball which has proved satisfactory in previous designs, and then change it if necessary. Where axles are bought complete the position is usually predetermined. The position of the ball in that case may be right or wrong, and if the latter, the axle manufacturer cannot be blamed, for he has no way of determining the correct location.

Board lay-outs can then be made to assure the correct alignment of the drag link and determine the desirable length of steering arm, but much better results are obtainable with the equipment described in the following.

For determining the proper position for the steering-knuckle ball, the axle-roll gage has been devised. (Fig. 1). It consists of a metal plate *A* with a clamp for attaching it to the car frame. This plate is faced with wood, so that thumb tacks can be used for attaching 4 by 9½-in. chart paper. At the center of the plate there is a ½-in. ground pin, threaded at the outer end to take a nut and lock-nut. Two levers *B* and *B'* are assembled with a sliding fit over the

Fig. 2—Use of dial indicator for determining correct position of steering arm ball.

pin. The outer ends of these levers are slotted 1¼ in. from the ends to allow for adjustment. On these levers at *C* and *C'* are cups into which small pencils are fitted. If indicator paper is used, brass pointers are used instead of pencils. A light coiled spring is placed behind the pencil or pointer in either case. The cap screw is then screwed on. These cups are 4 in. from the pivot pin.

Into the slotted ends of the levers, ball socket joints are fitted. These in turn are connected to rods which are fitted with ball socket joints at their opposite ends. The ball sockets are assembled in T clamps fastened to the axle with bolts. When the instrument is set up, adjust the length of the rods (which are two-piece telescoping), so that levers *B* and *B'* are in a straight line perpendicular to the rods. The rods should be parallel to the ground. When all of the equipment is properly set up, charts may be taken with different road conditions and brake applications. The axle roll will be recorded on the chart in the form of two arcs. By connecting opposite ends of the arcs, a point of intersection will be secured. This then is the center of rotation of the axle. This determination disregards the effect of the kick shackle, but experience has shown this to be negligible in most cases.

The backward movement of the axle produced by road impacts and braking should be determined by other means. If the job has a kick shackle, the movement of that shackle will determine it. When the axle movement is known, the knuckle-arm position should be moved up from the intersection of the lines on the chart, or the axis of axle roll, until the horizontal distance between the lines is equal to the rearward axle movement

Usually four charts are taken, under different conditions, and the mean point of the line intersections is taken as the center of axle roll. This produces good results. This ball position is 2 in., 3 in. or even further away from the correct position, and it is usually high. As the divergence of the lines on the chart gives a measure of the horizontal movement of the ball, it immediately shows why an incorrect position results in wheel fight.

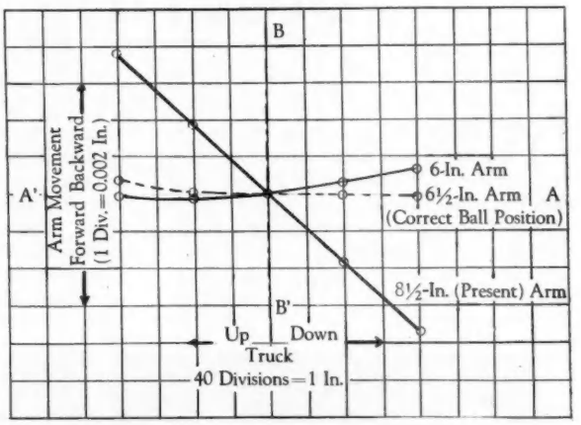


Fig. 3—Graph showing movements of (dummy) steering-arm ball in fore-and-aft direction plotted against up-and-down movement of vehicle frame, for various lengths of steering arm (pitman arm.)

After the correct knuckle-arm-ball position has been determined, the position of the steering-arm ball should be determined. One method is shown in Fig. 2, which is a photograph of the dial indicator set up for this purpose. With this set-up, a dummy steering arm is placed on the steering gear cross shaft, free to rotate on the shaft. A dial indicator is fastened to the frame in such a manner that fore and aft movements of the drag link are recorded. The front end of the vehicle is then raised and lowered by various increments, usually of ½ in., and two readings are taken each way; i.e., ½ in, 1 in., up and down. Corresponding readings are taken on the indicator, and the direction of motion as noted. Usually it is advisable to record three sets of readings for each length of steering arm and take an average. The averages are then used to plot a graph as shown in Fig. 3. On this graph, vehicle movement — up and down—is plotted against arm movement—forward and back. An analysis of this curve will show that the ideal ball position is the one for which the curve departs least from the normal line *A-A'*. When the high part of the curve is to the left of line *B-B'* the ball position is too low, and vice versa.

When the proper ball position has been found, it does not prove that the length of the arm is correct. The proper length of the arm depends upon the location of the gear, and any deviation from the correct length may be compensated for by raising or lowering the gear on the frame.

Lighter Color Should Be Used on Upper Part of Body, Haarz Says

IN a paper entitled "Beauty Sells Cars in 1934," William G. Haarz, Jr., Graham-Paige Motor Corp., dwelt on the importance of color as a sales factor.

"Five or six years ago," he said, "many cars were finished with the upper structure in black or dark colors, contrasting with lower areas in light color values. Cars were very much higher than they are now, and this mode of color distribution was intended to engender an aspect of lowness. The dark color was regarded as the 'heavy' color and was thought to give an impression of weight, visually lowering the car silhouette.

"More recently the error of this line of reasoning was disclosed. A study of the color masterpieces of the world in ceramics, rugs, paintings, and tapestries, as well as color distribution in nature, reveals a consistent color relationship of high, middle and low values with high-value colors at the top and low-value colors at the base. The high or light value color is the sky, the middle value color is the horizon and the low or dark value color is the foreground in nature's landscape. This relationship is also carried out in rug color arrangements, vases and the like. The dark color represents weight and is used to direct the eye toward the edges or bottom of the design. On an automobile, lower body areas finished in darker colors than are used on the upper portion create an aspect of greater safety by strengthening the impression of a low center of gravity and eliminating the top-heavy look, which invariably results from placing a large mass of a dark color on top of a light color. That is why we have produced so many cars finished in this manner in late years."

Mr. Haarz ventures the opinion that with present-day car designs what they are, one over-all color is adequate, enhancing streamline design and meeting requirements of newness and production economy. He believes that green will be a popular color in 1934 and says his firm has selected a number of attractive greens.

Better Chassis Lubrication Service Awaits Clearer Specifications

STANDARDIZATION and simplification of chassis lubricant specifications—the need for which from a service standpoint was first pointed out in *Automotive Industries* during the Summer of 1931—was urged in a paper by A. J. Blackwood and A. J. Spencer, Jr., of the Standard Oil Development Co. They presented a table showing the lubricant recommendations for seven representative 1933 cars, and commented that it was immediately apparent that car manufacturers were in wide disagreement with respect to the proper lubricant for various parts, and that several had no definite recommendation, simply designating gear oil or grease, and hoping for the best. Following are observations made by the authors with respect to lubricants of various important chassis parts:

Starter, Generator, Distributor—Greater uniformity in the lubrication of these parts would seem to be a simple matter, since there is no particular lubrication problem involved. Over-lubrication of the shaft sometimes results when using grease, and an excess may interfere with the automatic spark mechanism. There is no reason why an engine oil should not be satisfactory for this service, if the design and location of the unit are given careful attention.

King Pins, Drag Links and Tie Rods—Correct lubrication of these units is of the utmost importance, since on their proper functioning depends the ease of steering and ultimately the safety of passengers. On two popular makes of car, over-lubrication of the king pins will permit excess lubricant to reach the brake linings, if the tell-tale vent is clogged.

These parts operate under relatively light loads and very slow movement. In addition, they are exposed to dirt and water. Therefore, a grease consisting of a low-viscosity oil and a water-resistant soap, made up to medium consistency, should be entirely satisfactory. Oil-company service stations urge more uniformity in regard to lubricant type and recommended frequency of lubricant application to these parts.

The introduction of independent front springing on 1934 cars has resulted in radical changes in these parts, and this would seem to afford a good opportunity to initiate a program of greater uniformity in regard to lubricant recommendations.

Springs and Spring Shackles—Lubrication of the spring leaves ordinarily consists in either spraying or painting the lubricant on the side of the leaves, or in the case of the enclosed spring, through grease fittings provided. A few cars have inserts, so do not need lubrication.

The shackles operate under extremely severe conditions. They are exposed to dirt and water, carry heavy unit static and shock loads, and the parts move slowly with respect to one another. Operating temperatures approximate atmospheric temperatures, except for the friction heat developed.

The authors made a test on Tryon shackles and found that when these were lubricated with the recommended 600-W oil, the bearing surfaces at the end of the test were dry and dirty, and the pin was almost empty when lubricated with S.A.E. No. 160 transmission oil, bearing lubrication was poor and the bearing dirty, while the pin was almost empty; lubricated with pressure-gun grease, there was a good lubricating film on the pin at the end of the test, and the pin was still half full. These results were obtained with the plain type of shackle, which is now gradually disappearing.

Ball-bearing shackles require disassembling and cleaning in order to satisfactorily lubricate them, and consequently servicing cannot be done at the ordinary oil-company service station.

Rubber-shackle squeaks are frequent complaints at service stations. After having a car lubricated, the owner frequently blames the service station job if the squeak persists. An alteration in the design to facilitate application of a suitable lubricant to the rubber joint without dismantling the unit is desirable.

In addition to water from wet road surfaces and rain, the increasing use of high-pressure-water cleaning methods has emphasized the necessity for a water-resistant lubricant in certain chassis parts.

The general problem of shackle lubrication would be simplified if the car manufacturers would design their equipment for pressure-gun grease. Satisfactory lubrication would be assured with a well-made product consisting of a medium-viscosity oil and a water-resistant soap, such as calcium or aluminum. Such a product would reduce leakage, resist water, and provide adequate lubrication.

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Factors Affecting Tire Noise—Character of Noise as Important as Volume

VARIOUS factors affecting tire noise, such as the design of the tread, the character of the road surface, etc., as well as methods of measuring these noises were discussed in a paper on tire noise presented by Arthur W. Bull of the U. S. Tire Co. He reaches the conclusion that the audiometer, which measures the intensity of the noise, is not well adapted to the study of tire noises, because the character of the noise is fully as important as its volume. Among other things he points out that movement of the tread in contact with the road is the cause of a howling or squealing noise produced on turns at relatively high speed. In this case the whole tread is trying to resist a lateral skid, and lateral slippage of part or all of the tread design occurs when the centrifugal force exceeds a critical value. Large-section, low-pressure tires have a relatively low resistance to lateral forces.

A series of tests is described in which the noise of a tire running on a steel wheel is picked up by a microphone and recorded on aluminum records which can be replayed indefinitely and amplified as desired, for direct comparison by ear.

From the results of his investigation Mr. Bull draws the following conclusions: Tire noise varies widely in character and intensity, depending on the tread design and on the conditions of operation. Reduction of noise has been accomplished by a study of the sources of noise, and of the effect of different elements in the tread design.

Tires combining quietness and good antiskid properties are now available.

Better Chassis Lubrication Service Awaits Clearer Specifications

(*Concluded from page 97*)

Steering Gears—In light passenger cars a light engine oil probably is adequate for the steering gear, provided leakage does not occur. In heavy-duty truck and bus operation the service is much more severe, and of late many operators have found it expedient to use an extreme-pressure lubricant.

Occasionally car instruction books recommend seasonal lubricant changes, but no provision is made for draining out the old lubricant, and the steering gear must be dismantled.

The authors' recommendation for this unit is a heavy fluid grease, preferably of the extreme-pressure type. They also recommend that car manufacturers provide drain plugs, filling plugs of adequate size at the proper lubricant level, and an improved design which will prevent leakage of such fluid lubricants.

Clutch-Release Bearings — Failure of the clutch-release bearing due to lack of lubricant, and damage to clutch plates from over-lubrication, are frequent troubles. It would seem preferable that the lubricant fitting for this bearing be placed under the hood, rather than under a removable plate in the driving compartment floor. When servicing a car using the latter design, grease is frequently transferred to the upholstery while the attendant is lubricating the clutch release bearing.

Car manufacturers should give serious consideration to the design of this unit as regards lubrication. The fitting should be readily accessible. To guard against over-lubrication the instruction manuals might call for lubrication twice per year (based on an average of 10,000 miles per year) with an oil reservoir which will take care of 50 per cent additional mileage. In addition, instructions could be given to lubricate more often if the car were driven over 10,000 miles per year. There is no evident reason why it should be necessary to lubricate this fitting with grease.

Wheel Bearings—Front-wheel bearings can be lubricated in any of three ways, as follows:

1. The hub cap is removed, packed with grease and replaced. This method is unsatisfactory, as frequent repetition will soon fill the entire hub and force the lubricant out at the back end onto the brake lining.

2. Some manufacturers provide a fitting or a plug in the hub, usually at the center, through which the lubricant is forced. Eventually the housing becomes full, and end leakage occurs, the same as with the first method.

3. The wheel is removed and the bearings are washed, packed with lubricant, and replaced. This is the safest and surest way to avoid lubricant leakage out on to the brake lining.

Few oil-company service stations can employ the third method, since trained mechanics are necessary to properly replace the bearings and wheels.

Rear wheel bearings are generally lubricated through fittings on the axle housing. Some car builders provide automatic lubrication from the differential, and from the service point of view this practice has considerable merit, since with good lubricant retainers at the outer end, leakage to the brake lining is not likely to occur.

The authors' general recommendation for a wheel-bearing lubricant is a good heat-resistant grease of medium consistency, such as might be made from soda soap, and a fairly viscous mineral oil.

Universal Joints—Of all the chassis parts, the universal joints probably get the most abuse, and are the greatest sufferers from neglect. The lubrication requirements are very severe, owing to high bearing pressures, high speeds and loads, and a centrifugal action which tends to throw the lubricant from the joint. The more modern units are better designed to take care of leakage. With needle bearings, the lubrication interval is greatly increased.

While universal-joint manufacturers usually provide readily accessible fittings for lubricating the joints, car manufacturers are not always careful to so locate nearby parts that the lubrication fittings can be easily serviced. On one particular car, owing to the location of the brake equalizer rod, it is impossible to remove the screw plug except with a special screw driver with a short right-angle bend near the blade end.

The authors' recommendation for a standard universal-joint lubricant is a properly manufactured heat-resistant type of soda-soap grease of fairly heavy consistency, using a moderately heavy mineral oil base stock.

While splined joints are frequently neglected, they present no particularly difficult lubrication problem, and a satisfactory water-resistant lubricant will work well at this point. Fluid lubricant seems preferable, owing to its ability to work around the shaft from the point of application. A worn shaft may require a heavier lubricant, such as pressure-gun grease, to minimize leakage.

Water Pumps—Of those water pumps which require lubrication there are two general types, one requiring a waterproof grease and the other either oil or pressure-gun grease. Complaints by customers on water pump leakage are due usually either to poor packing or insufficient taking up of the packing nut. Over-lubrication or use of an incorrect lubricant results in contamination of the cooling system, with resultant clogging. By uniformity in design, one lubricant would suffice for all water pumps.

Suppression of Ignition Interference with Radio Is Up to the Car Engineers

THAT suppressing high frequency ignition interference with radio reception will become a problem of real automotive concern, was predicted by Virgil M. Graham, radio engineer, Stromberg-Carlson Telephone Mfg. Co., in a paper on "Some Problems of Automotive Radio."

The author quoted E. T. Dickey, of the Radio Engineering Department of the RCA-Victor Company, to the effect that "the distances at which ignition interference is noticeable from a car increase with the frequency, making the use of a high-frequency receiver along a main highway almost impossible. Although we have had our all-wave sets on the market for only about a month, there are already numerous complaints coming in concerning interference in the high-frequency ranges from automobile ignition systems."

Mr. Graham pointed out that the higher frequency bands are rapidly coming into extensive use, for police work, aircraft landing beams, and similar purposes, and this means that there will be a popular demand for the clearing up of the interference situation as soon as the owners of such radio equipment find out the cause. He also pointed out that the regular interference suppression means used when a receiver is installed in the car, is equally effective in the higher frequency ranges, so that if all cars, buses and trucks had suppression means installed, there would be no complaints.

The author went on to say that while the radio people at present are taking the burden of such complaints, a considerable portion of the burden will be shifted to the automotive industry when the public realizes the situation. Some portion of the total interference will be laid on the public utilities, for interference from signs, dial telephones, trolley noise, etc., but automobile-ignition interference is generally readily recognizable by the user of the receiver and can be traced more readily than some of the others.

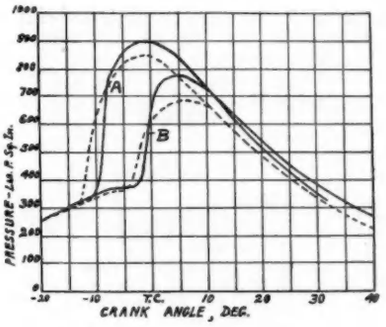
High-Speed Motion Pictures Used to Trace Flame Travel in Diesels

FLAME propagation in a compression-ignition engine, traced by means of a high-speed motion picture apparatus, used at the Langley Memorial Laboratory, was discussed by A. M. Rothrock, associate physicist, National Advisory Committee for Aeronautics, in his paper, "A Photographic Study of Combustion in a High-Speed Compression Ignition Engine."

The engine used in these tests is a single-cylinder unit with disk-shaped compression chamber in the head. One side of the chamber is formed by a cylindrical glass disk of 2½ in. unsupported diameter, while on the other side of the chamber is located an optical indicator actuated by the deflection of a 2-in. diaphragm forming the side of the combustion chamber. The diaphragm motion is recorded on a film mounted on a drum by means of a light beam and a pivoted mirror, the film turning at a linear speed of 100 in. per sec.

The following conclusions are drawn from the investigation:

1. With a short ignition lag in a quiescent combustion chamber the burning starts from around the spray envelope and from there spreads throughout the combustion chamber.



Graph showing effects of injection advance and jacket temperature on pressure curve

A—Injection start 20 deg. ahead of top center; B, 10 deg. Dotted line represents pressure curve obtained with 300-deg. Fahr. jacket temperature; solid line, with 150 deg. Engine r.p.m., 570; compr. ratio, 14.8; cylinder displacement, 137 cu. in.; fuel quantity, 0.00025 lb.

With a long ignition lag the burning may start at any point in the chamber. In either case the burning may start at one or more than one point.

2. The course of the combustion, aside from the original chemical properties of the fuel, is controlled by:

a. The time interval between injection and the start of combustion.

b. The temperatures and pressures existing in the combustion chamber during this time interval.

c. The temperature and pressure at the start of combustion.

d. The distribution of the fuel at the start of combustion.

3. The ignition lag in an engine with a quiescent combustion chamber should be decreased to the value required to prevent objectionable rates of pressure rise. The ignition lag should not be decreased to less than this value because by doing so the combustion efficiency of the engine is decreased.

4. In case the ignition lag in the engine is too long, it may be shortened considerably by increasing the temperature of the engine coolant.

5. If the ignition lag of the engine is short, increasing the temperature of the engine coolant decreases the ignition lag sufficiently to decrease the rate of pressure rise and the combustion efficiency of the engine. Consequently, if the rate of pressure rise in the engine is not excessive, increasing the coolant temperature does not present any advantages.

Specific Fuel Consumption and True Economy

CONTENDING that it is fallacious to refer to the specific fuel consumption of an automobile as economy, in view of the low thermal efficiency of the automobile engine, E. H. Shepard of Chevrolet pointed out in his paper that, fuel consumption of an automobile engine is to a certain extent influenced by the design of its inlet manifold.

In the case of a six-cylinder engine there is little to choose, according to the author, between a three-port and a four-port design, as regards the final results, but the three-port will usually require the most "tailoring."

To insure uniform mixture flow through the manifold, it is desirable to avoid pockets, unless they are exhaust heated. Irregular curves, such as S-bends, should also be avoided.

Unfortunately, even though the distribution is uniform at full throttle, it may be far from uniform at part throttle, which condition corresponds to medium car speeds on level roads. It is then necessary to compromise again, and it is better to favor the distribution at part load, for the reason that the miles per gallon will be reduced less if the mixture is a little too rich at full throttle than at part throttle.

Once the correct amount of fuel is in the cylinder, the amount of mechanical energy obtained from it will depend upon spark-plug location, width of spark-plug gap, spark timing (which should be more advanced at part throttle than at full throttle for the same speed), and the form of the combustion chamber. Piston rings are now available which will prevent projections of oil into the combustion chamber, and some of the former restrictions on spark-plug location have therefore been eliminated.

In calibrating a carbureter for a new engine, it is advisable to first determine in road test the particular mixture ratio which will give the maximum miles per gallon at any given car speed, over the whole driving-speed range, and also the richest mixture that can be used at any given speed without decreasing the mileage per gallon by more than ½ or ¾, also over the whole speed range.

This procedure is repeated at full throttle, except that in this case the leanest practical mixture ratio is determined. Usually, the engine power remains substantially constant if the mixture is enriched by from 6 to 8 per cent over the lean limit thus established.

These road results are checked with the flow bench in the laboratory. This latter equipment enables the engineer to calibrate a carbureter without fitting it to an engine, once the mixture-ratio requirements of the particular engine for various speeds and loads have been determined.

The accelerating-pump charge, according to Mr. Shepard, should be the volume that will wet the manifold the same as full-throttle operation.

External Broaching As It Is Being Used in Automotive Manufacturing

(See Abstract of Paper by Joseph Geschelin on Page 101)

Table I

Description	Material	Operation	Production per Hr.	Pieces per Grind	Type Broach	Key No.	
Shift Rail	Steel	3 Slots	200	1,500	Pull	1	
Shock-Absorber Wing	Steel	Comp. Profile	200	1,200	Pull	2	
Clutch Lever	Steel	Two Cam Surfaces	300	2,000	Push	3	
Clutch Disc	Cast Steel	Lug Profile	275	2,000	Push	4	
Differential Case Pin Bearing	Cast Iron	Semi-Circular Bearing	60	800	Pull	5	Fig. 12
Steering Support Arm	Malleable Iron	Serrations	200	3,000	Serrated Pull	6	
Connecting Rod	Forging	Facing	200	1,500	Double Face Pull	7	
Connecting Rod	Forging	Slitting	200	1,500	Pull	8	
Gear Sector	Cast Iron	Gear Teeth	225	3,500	Pull	9	
Steering Sector	Steel	Gear Teeth	175	1,200	Push		Fig. 6
Clock Base	Zinc Die Cast	Surface	350	5,000	Push		
Crankshaft Bearing Cap	Cast Iron	Finish Joint Face and Ends to Size	398	31,500	Vertical Push		
Crankshaft Bearing Cap No. 4	Cast Iron	Step for Gasket	772	35,000	Vertical Push		
Connecting Rod	Forging	Faces Large End	490	21,600	Vertical Push		
Cylinder Block	Cylinder Cast Iron	4 Bearing Cap Surfaces	112	7,000	Horizontal		
Motor Rotor Hub	Steel	Four Segments	65	5,000	Horizontal Pull		Fig. 8
Bearing Cap	Cast Iron	Slot Face	480	—			Fig. 9
Shock-Absorber Wings	Molybdenum Steel	Broach Radii	550	25,000	Horizontal Pull		
Universal Joint Rings	Forging	Four Cross Holes	600	25,000	Vertical Push		Fig. 10
Connecting Rod	Forging	Bolt Boss Contours	700		Horizontal Pull		Fig. 11
Speed Reducer Rings	Cast Iron	Deep Radial Slots	14	4,000	Horizontal Pull		
Cylinder Block	Cast Iron	Bearing Pads	12	4,500	Horizontal		
Clutch Lever	Forgings	Two Cam Surfaces	1,800	—	Vertical Push		
Coarse Steering Sector	Forging	Roughing	325	60,000	Horizontal Pull		
Free-Wheel Clutch	Forging	Outer Contour	150	—	Vertical		
Free-Wheel Cam	Tool Steel	Four Tongues	180	—	Vertical		
Connecting Rod	Forging	Big End Radius and Faces	360	—			
Steering Sector	Forging	Roughing 5 D.P. Teeth	600	—			
Balance Weight	Forging	2 oper. Inside Surfaces Outside Surfaces	225	—	Vertical	10	
Connecting Rod	Forging	Face Large End	450			11	
Universal Shaft Joint	Forging	Face 2 Trunnion Ends	600			12	
Shock-Absorber Part	Forging	Face both sides, projection and front ends	1,000			13	
Connecting Rod	Forging	Finish 2 contact faces trim both sides and both back bolt bosses	600			14	Fig. 13
Valve Rocker Arm	Forging	Finish Radius and Side	600			15	
Rod Shackle	Forging	Four joint faces	600			16	
Connecting Rod Cop	Forging	2 Contact Faces and Both Sides	600			17	
Steering Spindle	Forging	Surface Broaching two sides	120			18	
Shock-Absorber Cam	Forging	Finish Radius	1,000			19	
Steering Column Clamp	Malleable Iron	Finish Radius and 2 contact faces	900			20	
Starter Head	Forging	Finish radius between trunnions	600			21	
Differential Gear Pinion	Forging	Rough Teeth	3,500			22	

Table II

Description	Material	Operation	Stock Removed	Tolerance on Finish	Surface Speed Cutting Ft. per Min.
Crankshaft Bearing Cap	Cast Iron	Finish Joint Face & Ends to Size	0.621 cu. in.		24
Crankshaft Bearing Cap No. 4	Cast Iron	Step for Gasket	0.221 cu. in.		18
Connecting Rod	Forging	Faces Large End	0.087 cu. in., two caps		22
Cylinder Block	Cylinder Cast Iron	4 Bearing Cap Surfaces	1.710 cu. in.		25
Shock-Absorber Wings	Molybdenum Steel	Broach Radii	0.600 on side	0.0005 in.	
Connecting Rod	Forging	Bolt Boss Contours	1/32 to 1/16		
Cylinder Block	Cast Iron	Bearing Pads	0.032 in.	0.0005 in.	
Clutch Lever	Forging	Two Cam Surfaces	1/16 in.		
Universal Joint Rings	Forging	Four Cross Holes	1/16 in.	0.0005 in.	
Coarse Steering Sector	Forging	Roughing	0.370 in.		
Free-Wheel Clutch	Forging	Outer Contour	3/16 in.	0.0005 in.	33
Free-Wheel Cam	Tool Steel	Four Tongues	0.20 in.	Commercial	20
Connecting Rod	Forging	Big End Radius and Faces	1/8 in.		27
Steering Sector	Forging	Roughing 5 D. P. Teeth	0.410 in.	0.001 to 0.0005 in	33
Balance Weight	Forging	2 operations. Inside Surfaces Outside Surfaces	3/16 in.	0.001 to 0.0005 in.	25

An Appraisal of the Various Types of Rotating Wing Airplanes

FOUR types of rotating-wing aircraft were discussed in a paper by John B. Wheatly of the N.A.C.A. The author introduced the subject by stating that almost all the hazards encountered in flying an airplane are connected with the phenomenon of a gradual weakening of control as the flying speed approaches its minimum. A rotating-wing aircraft suffers very slightly from these handicaps, because the relative velocity of the lifting surfaces to the air is independent of the translatory velocity of the machine and is always large, so that the angle of attack of the lifting surfaces is well below the burble point. The four types discussed are the following:

The Helicopter, a flying machine that normally derives the major portion of its sustentation from one or more power-driven lifting propellers rotating about an approximately vertical axis.

The Cyclogiro, which consists of a fuselage of conventional form supported by two power-driven paddle-wheel rotors, one on each side, rotating about the lateral axis. The rotor consists of three or more blades which are oscillated by cams during rotation in such a manner as to develop a resultant force, the direction and magnitude of which are controlled by changing the amplitude and phase angle of the oscillation with respect to the direction of flight, by adjustment of the cams.

The Autogiro (which has been illustrated and fully described in these pages and of which it is therefore unnecessary to give a definition).

The Gyroplane, an aircraft that develops the major part of its lift by a freely rotating four-bladed rotor in which opposite blades are rigidly interconnected and attached to the hub in bearings that permit the blade pair to rotate freely about an axis approximately parallel to the span axis of the blades. The axis of rotation of the rotor is substantially vertical. In forward flight the lift on opposite sides of the plane of symmetry is equalized by a rotation of the blade pair in the hub bearing which is governed by a controllable cam in the hub mechanism.

In the paper the author appraises the various types according to an arbitrary system of valuation of maneuverability and controllability, reliability and emergency landing, low-speed performance, high speed, simple operation and cost, and the marks under the various headings total up to 100 for the conventional airplane, 75 for the Helicopter, 100 for the Cyclogiro, 120 for the Autogiro and 120 for the Gyroplane.

Advantages of Inertia Starters for Diesel Aviation Engines

INERTIA starters have not yet been used for Diesel engines to any extent, according to R. P. Lansing, vice-president of the Eclipse Aviation Corp. This, he thinks, is due mainly to the fact that very little is known regarding this type of starter in the Diesel industry. Its greatest advantage for this work is that comparatively high cranking speeds may be obtained, which is a great help in starting an engine in cold weather.

The first application of an inertia starter to an oil engine was in the case of a well-known aviation Diesel engine. Prior to adopting the inertia starter comparative tests were made with numerous other available types with varying degrees of satisfaction. However, the inertia starter was found to be most efficient and reliable, and as a result was adopted as standard equipment on that engine.

The inertia starter used was a combined hand and electric starter. The hand form of the starter weighed approximately 25 pounds, and it was only necessary to add another 7 pounds to include an electric motor. This motor is mounted directly on the starter so as to engage directly with the starter flywheel. Obviously, in this case the electric acceleration was invariably used, falling back on manual acceleration only when the battery charge was low or electrical facilities were interrupted.

This inertia starter turned the Diesel aviation engine over at an instantaneous momentary speed as high as 200 r.p.m. with between 4 and 8 complete revolutions of the crankshaft, depending upon the stiffness and temperature of the engine. A glow plug was used in each cylinder of this engine.

A Survey of External Broaching In Automotive Production

A QUICK survey of the potentialities of external broaching in automotive production was given by Joseph Geschelin, engineering editor, *Automotive Industries* in his paper, "Potentialities of External Broaching Visioned from Analysis of Current Applications," which was read at the Production Activity session.

The paper was profusely illustrated with external broaching set-ups gathered from many sources. An important feature was the description of a number of production machines which are to be placed on the market in the near future.

A detailed analysis of over forty applications out of some sixty-five that were studied in this connection, is found in Table I. The work ranges from simple finish-face operations on small parts to the finishing of accurately controlled cam contours and the broaching of accurately finished semicircles. Surface speed of broaches from 18 to 33 ft. per min., while tool life runs from 800 pieces per grind to 60,000 pieces per grind, the latter, in roughing the teeth of a coarse-tooth sector.

As an index of the ability of the process for removing stock and controlling size, a summary of some pertinent data is given in Table II.

"Considering external broaching as a technical process which is undergoing development and refinement during a period of rapid expansion," said Mr. Geschelin, "I think it would be premature to generalize about its ultimate possibilities or its effect upon the other production processes which have been so firmly entrenched in automotive production shops. Suffice it to say that external broaching has made tremendous strides in the automotive industry and in a relatively short time has attracted attention in many quarters. On the basis of the evidence accumulated for this paper I can say that many large plants are experimenting with it and those who have had experience with it are contemplating additional applications. Perhaps the best measure of this activity may be gained from the fact that a relatively large group of machine tool builders have developed new and improved broaching equipment which will undoubtedly be on the market about the time this paper is read."

Commendation for and Criticism of Multi-range Transmissions

C. D. PETERSON, executive engineer of Spicer Manufacturing Corp., presented a paper on multi-range transmissions. He pointed out that in truck work above the light-delivery class it is now customary to use transmissions with from four to twelve speeds. It is a difficult matter to establish the number of speeds and the different transmission steps for general use, as there are wide variations in conditions of truck operation in various parts of the country. However, transmissions that have a high degree of acceptibility to truck operators in general have been evolved. "More transmission capacity," Mr. Peterson said, "is required for vehicles of low ability, because such vehicles are operated through the gears a greater part of the time."

Multi-range transmissions, owing to their many speeds and wide steps, have been the cause of complaints on the part of drivers with respect to hard gear shifting, but such complaints are now subsiding as a result of the sliding clutch replacing the sliding gear in many places, of improved chamfering of the clashing edges of the gears, and of the growing skill of drivers with respect to double clutching.

There is a tendency toward the wide use of five-speed transmission with direct drive in either fifth or fourth speed, the latter having an overdrive. With the former type of transmission a "faster" rear axle is used. Advantages claimed by manufacturers for the former type of transmission are: that it eliminates considerable running in gear, that shifting down to fourth speed is relatively easy, owing to the small step, and that the propeller-shaft speed is lower. Criticisms of this transmission by operators include the following: Increased gear-shifting is required, owing to the smaller direct-drive ability, and often two shifts down must be made to negotiate a grade which with a well proportioned over-drive transmission could be negotiated with a single shift. To compensate for loss of direct-drive ability, larger engines are asked for, which if supplied, negative some of the advantages of the direct-in-fifth transmission.

The over-drive five-speed transmission, even though it does entail higher propeller-shaft speeds than direct-on-fifth, is meeting with increased favor because gear shifting between direct-drive and low gear is reduced, direct-drive ability is increased, fuel economy and general smoothness are improved, and engine speed is reduced for open-road driving in over-drive. Gear shifting between direct and over-drive and vice versa is easily accomplished due to a small step in ratio between direct and over-drive. Further, when shifting into over-drive, engine speed is reduced for a given vehicle speed, vibration is less pronounced and smoother operation results, while a shift from fifth to fourth gear causes an increase in engine speed for a given vehicle speed, vibration is more pronounced and smoothness is sacrified. This is an important reason influencing experienced operators in selecting over-driven trucks.

At one time over-drive was used mostly for empty trucks, or when light loads were being transported, to reduce running time. However, with the stepping up of vehicle speeds, the portion of the time of total operation spent in over-drive, under all conditions of load, became higher until it is now quite common practice to over-drive as much of the running time as possible. Ground helical gears have reduced gear noise to such an extent that the major criticism of over-driving has been eliminated.

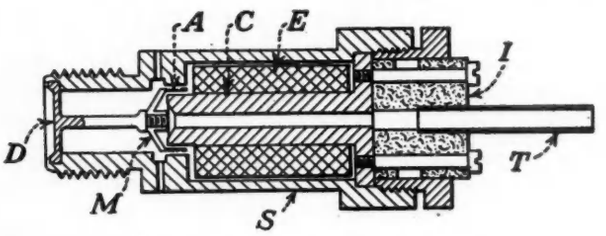


Fig. 1—Pressure element of M.I.T. indicator

A New Instrument for the Study of Cylinder Performance

A NEW instrument for the study of cylinder performance was described in a paper by C. F. Taylor, C. S. Draper, E. S. Taylor, and G. L. Williams, all of Massachusetts Institute of Technology. The basic element of the new instrument is the pressure element (Fig. 1), which can be screwed into a spark-plug hole. It comprises a small diaphragm exposed to cylinder pressure, whose motion is imparted to a coil of wire which moves axially in a radial magnetic field. The electromotive force generated by the coil motion may be amplified and analyzed by means of an oscillograph, or the energy output may be integrated by means of a suitable instrument.

As shown in the drawing, a very light coil of wire *A*, is wound on a magnesium spider *M*, which is supported in a magnetic field by the steel diaphragm *D*. The magnetic field is furnished by coil *E*, wound on a soft iron core *C*. The magnetic path is completed through the shell *S*, of the instrument. The leads to the coils are brought in through the Bakelite block *I*, and cooling air is introduced through tube *T*. The diaphragm is directly exposed to engine cylinder pressure, and the change of pressure during the engine cycle results in a corresponding movement of the diaphragm and coil. This motion sets up an electromotive force in the coil which is proportional to the coil velocity. This velocity would be proportional to the rate of pressure change in the cylinder if the diaphragm and coil had no mass. The extent to which this ideal condition is approached depends upon the relation of mass to stiffness in the system; i.e., upon its natural frequency characteristics and damping.

Currents generated by the movement of coil *A* in the magnetic field are amplified by a capacity-coupled radio amplifier purchased in the open market. Current from a 110-volt alternating lighting system is used for operating the amplifier. The amplified currents are recorded by means of an oscillograph specially designed for engine research. It uses motion-picture film and is capable of recording a considerable number of successive cycles. When a measure of the total energy output is all that is needed, a simple output meter, such as a Rawson alternating-current galvanometer with a high rate of damping, may be substituted for the oscillograph. The oscillograph, used in connection with the pressure element and amplified, gives a graph of rate of pressure change vs. crank angle.

The instrument can be used to determine the frequency of the vibrations that manifest themselves in "pinging," and as a knockmeter, and it is believed that it can be developed also as a pressure indicator, which would necessitate the development of a circuit that would integrate the rate-of-pressure-change curves.

Who Got Industry's Accumulated Reserves These Past Two Years?

by Julian Chase
Directing Editor, Chilton Company

IN a statement issued upon the presentation of its report on the national income for the year 1929 to 1932, inclusive, Director Willard L. Thorp of the Bureau of Foreign and Domestic Commerce offered it as his opinion that "the completion of the income study for the United States marks a new step forward in our comprehension of our economic machinery and proccesses." So it does. It makes available vitally important data which have never before been so comprehensively or conveniently collated.

One of the things that impressed us in reading a summary of the report was the finding that "the income distributed by industries in 1929 was less than that produced to the extent of $2,000,000,000, this amount being retained by corporate and individual enterprises." In other words and in letters instead of figures, two billion dollars were added in that year to industry's reserves. It is well that they were and it is well, too, that other billions, more than five times as many billions, were also added to industry's reserves in the years preceding.

There have been those who have spoken publicly, some faintly pink and others brilliantly red in their philosophical and political complexions, who have said that industry's reserves are accumulated as insurance and safeguards for stockholders and other decorative but useless members of society. Some representatives of our government, even have also from time to time made statements which could be understood only as having been based on some similar belief. But the report of the income studies of the Bureau of Foreign and Domestic Commerce would indicate that this is not exactly correct. The report goes on to say that:

"In the following years, however, the amount distributed (by industry) exceeded the amount produced, a draft being made upon previously accumulated assets and surpluses. Such withdrawal of income exceeded income produced in 1932 by $10,600,000,000." Who got it?

Still later in the report we find that wages paid in 1932 totaled $31,595,000,000. They had amounted to $41,027,000,000 in 1931, $48,688,000,000 in 1930 and $52,867,000,000 in 1929. Dividends paid in the same years were $2,590,000,000, $4,311,000,000, $5,795,000,000 and $5,963,000,000 respectively.

Even when we make the absurd calculation of crediting to industry all interest paid within the nation in 1932 amounting to $5,506,000,000 and adding to it dividends paid we have, as a difference between that total and the $10,600,000,000 paid out by industry in excess of income produced, more than $2,500,000,000.

A substantial part of industry would literally have had to close up shop and send its workers to their homes in 1933 if there had not been a substantial storing away of part of the profits of previous and more prosperous years. *Automotive Industries* made a study of wages and dividends paid last year in the automotive industry and found that of the 45 companies considered, 28, or 62.2 per cent paid no dividends at all but continued employment and the payment of wages. This was true, also, of course, of large groups in all other industries.

The study on which the national income report is based ended with the year 1932. It is hoped and assumed that now that the work has been started it will be kept up and that other years will be added as the figures become available. The report for the year 1933 should be particularly illuminating in that undoubtedly it will show how industry's reserves, to a much larger extent relatively, went to the workers in the form of wages.

Developments of the past three years give us proof enough, if any additional proof were needed, that our economic structure will fall apart like the one horse chaise if industry does not set up adequate reserves. Even the most radical will have to admit that there can be no reserves if there are no profits. Profits are a fundamental economic necessity. Reserves are essential. They may sooner or later be made compulsory by law. They form the stoutest defense against ruinous unemployment. What with pensions and employment insurance or its equivalent in the offing, a definite and increasing responsibility rests on industry to rebuild its reserves. For this reason the day may come when the law will have as much to say about adequate profits for the employer as it now has to say about adequate wages for the employee—as much about the right, the needs, the duty of industry as about the rights and privileges of labor. If that time arrives, there is likely to be a legal insistence on adequate reserves.

Let us hope that before the government gets much farther into business, however, it learns how to do a better job than it has done with the railroads and, we are tempted to add, the Post Office. One fundamental difference in governmental and industrial management, as the former is exemplified today, is that so long as government can pile on taxes to produce needed revenues, it need not concern itself seriously with building up reserves for ordinary operations.

Production Income	
1929	$83,000,000,000
1930	70,500,000,000
1931	54,700,000,000
1932	38,300,000,000
Wages	
1929	$52,867,000,000
1930	48,688,000,000
1931	41,027,000,000
1932	31,595,000,000
Dividends	
1929	$5,963,000,000
1930	5,795,000,000
1931	4,311,000,000
1932	2,590,000,000

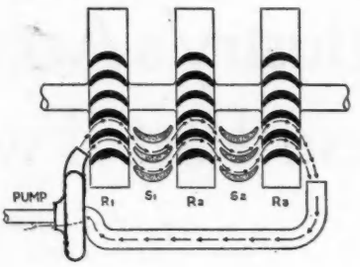


Diagram of fluid circuit in torque converter

Transmission Replaced by Converter in Leyland

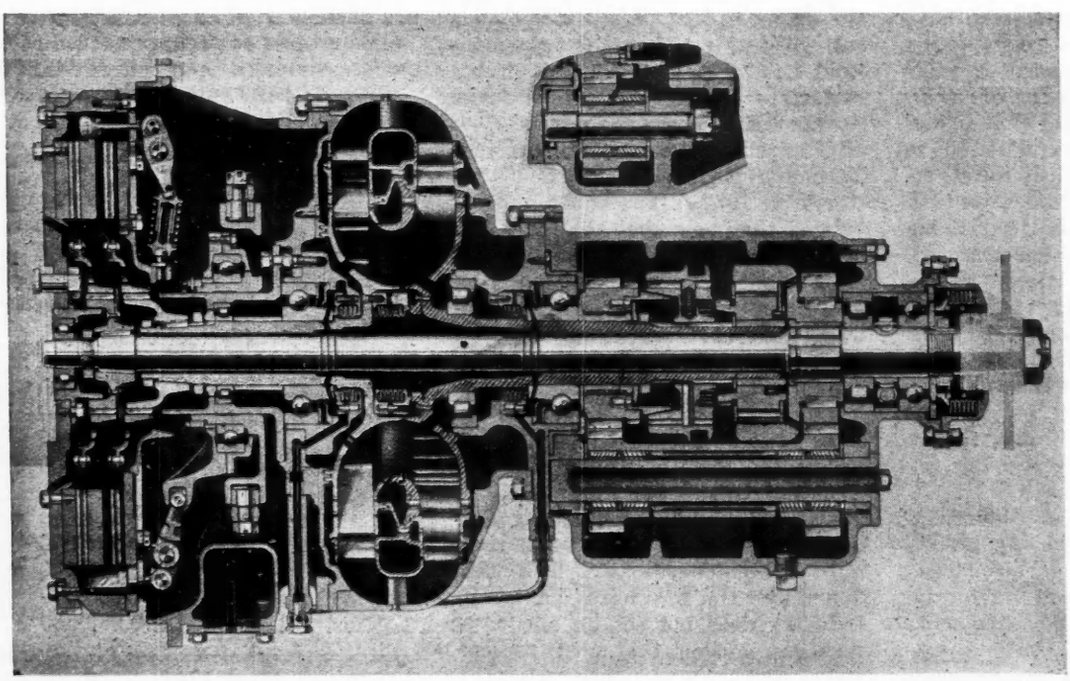
WHAT is probably the first hydraulic torque converter to be placed in production by an established manufacturer of commercial vehicles is being offered as the Leyland hydraulic torque converter, Lysholm-Smith System, by Leyland Motors, Ltd., of Leyland, Lancashire. All multiplication of engine torque for acceleration and hill climbing is effected hydraulically, so that a mechanical change gear is dispensed with entirely. Under ordinary conditions of operation the drive is direct, the hydraulic mechanism being disengaged. Changes in torque-conversion ratio take place automatically, but the change from hydraulic drive to direct drive is made by hand. Reverse is obtained through a special reverse gear which is combined with the double friction clutch and the hydraulic mechanism in a unit corresponding in form and size to the flywheel housing and transmission unit of mechanically driven vehicles. There are four control members, viz., the accelerator pedal, the brake pedal, the direct-drive pick-up lever and the reversing lever. The latter normally remains in the position for forward drive and is operated only when it is desired to back up.

Referring to the sectional view of the bus-type torque converter reproduced herewith, a double friction clutch is used. With the clutch-control mechanism in the position shown, the engine crankshaft is direct-connected to the main drive shaft, and the drive is therefore direct from crankshaft to propeller shaft. In the opposite position of the clutch-control mechanism the engine crankshaft is connected to a hollow shaft which carries the impeller of the hydraulic unit. There are essentially four elements to the bus-type hydraulic torque converter which in the longitudinal section of the assembly are shown from left to right in the following order:

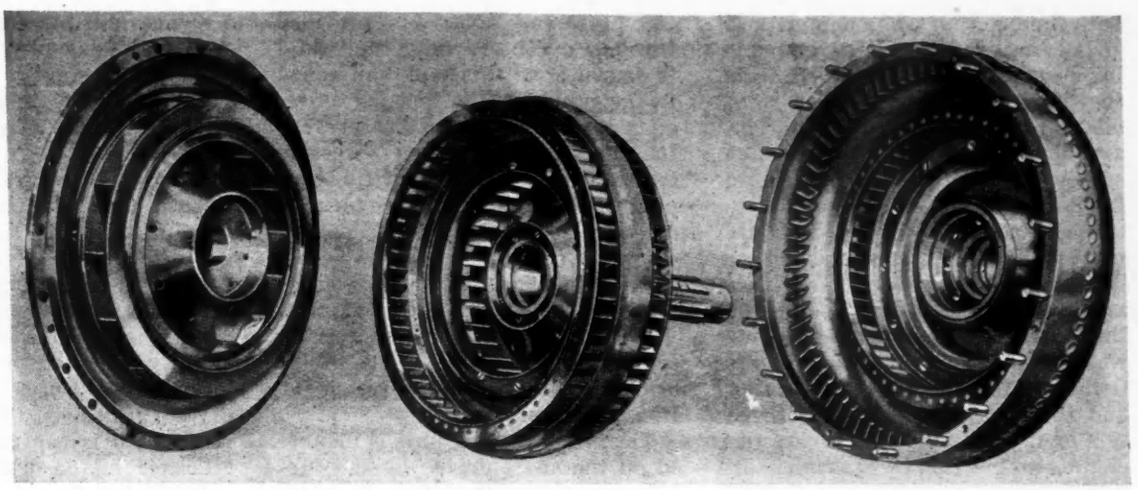
1. A double friction clutch which permits of connecting the engine either to the torque converter or directly to the propeller shaft, as required.

2. The hydraulic system of the converter.

3. The free-wheeling unit, to



Sectional view of bus-type torque converter



Pump wheel, rotor and stator blades of hydraulic torque connector

ed by Hydraulic Torque
nd Commercial Vehicles

Changes in reduction ratios are effected automatically except that shift from hydraulic to direct mechanical drive is made manually

prevent over-running of the converter.

4. The reversing gear.

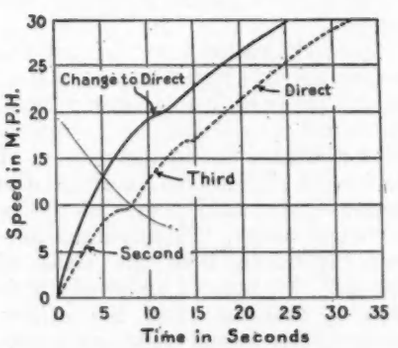
The double clutch is operated by means of a lever in the driver's cab, through a toggle mechanism. In connection with the friction clutches, it should be pointed out that they have very little work to do, as the vehicle is not being accelerated from a standstill to maximum speed on a slipping clutch, as with mechanical transmission. The engine can be idled with the clutch for the hydraulic drive engaged, and the car is then started and accelerated by merely depressing the accelerator. Whatever slippage there is up to the maximum speed attained through the hydraulic drive takes place in the hydraulic unit. When the direct-drive pick-up lever is moved to the direct-drive position, the vehicle is already moving at very nearly the speed corresponding to direct drive for the given engine speed, and there is therefore very little slippage at this clutch also.

As the change is made from hydraulic drive to direct drive, there is no interruption in torque, and no corresponding loss of speed. A direct result of this lack of interruption in torque is that the acceleration of the bus is smooth from the start to the maximum speed. This is of importance particularly in a bus, as it enables passengers to move toward their seats while the machine is under way, without danger of being upset by shocks due to gear changes. As an index of the smoothness of the hydraulic drive, the makers point out that the bus may be allowed to run backward downhill and then checked, stopped, and propelled forward by the accelerator alone without the slightest shock.

As regards efficiency, it is claimed that, owing to the steady acceleration, the use of a direct drive, and the provision of a free-wheeling unit, the Leyland torque converter compares favorably with the conventional mechanical transmission on the basis of fuel mileage. The hydraulic unit, moreover, protects the transmission members behind it against torsional vibration of the engine, and the engine cannot be raced in running downhill at high speed.

The torque converter consists essentially of the combination of a centrifugal pump with a three-stage hydraulic turbine in the same housing. The pump impeller, which is coupled to the crankshaft by means of the friction clutch already referred to, is similar in form to the impeller of the centrifugal pump of the water-cooling system. The turbine, which is connected to the propeller shaft through the free-wheeling unit to be described later, consists of a bladed rotor on which three separate series of blades are fixed in such a way that they are separated by two series of stationary blades fixed to the casing.

The housing is completely filled



Acceleration curves of Titan bus with hydraulic converter and mechanical transmission respectively

with fluid so that when engine power is being transmitted to the pump impeller, the fluid is driven from the pump to the first set of rotor blades R_1, then through the stationary blades S_1, where the direction of flow is changed so that the fluid impinges on the second set of rotating blades R_2. Next the fluid passes through the second set of stationary blades S_2, where it is again redirected to impinge on the third set of moving blades R_3, after which it returns to the pump. Owing to the shape of the blading and the fact that there are three sets of turbine blades in series, the engine torque can be multiplied in ratios up to 4.8 to 1.

Labyrinth seals are provided to prevent short-circuiting of the fluid between the rotor and housing, and other seals to prevent loss of fluid. Some slight leakage through these seals is desired, as it affords the necessary lubrication. Fluid thus lost collects in a small sump and is automatically returned to the reserve tank.

New fluid under certain conditions is likely to gasify slightly, and to ensure the removal of the gas and the replacement of the gasified fluid, a permanent leak to the reserve tank is provided through a control valve, and fluid is drawn from this tank and added to the supply in the housing as required, by an injector. To prevent the fluid from reaching excessive temperatures under conditions of prolonged use of the hydraulic drive under extreme conditions of operation, a small cooler is incorporated in the fluid circuit, and located outside the chassis frame. The fluid used in the converter consists either of a mixture of lubricating oil and kerosene, or of Diesel engine fuel.

The free-wheeling unit is mounted on the shaft driven by the turbine rotor and therefore is effective only when the drive is through the hydraulic unit. It has the effect of completely isolating the converter, which latter comes to rest immediately after its friction clutch is disengaged, so that there is no hydraulic loss when the drive is direct. The chief object of the free-wheeling unit, which is of the conventional roller type, seems to be to make coasting safe while the converter is engaged by its friction clutch.

The reversing gear is of the spur-gear type, but is provided with a synchronizing device which facilitates engagement and so speeds up maneuvering.

In operation, the engine is started up with the operating (reversing) lever in the neutral position. To start the vehicle, this lever is pushed into the position for forward motion and the engine is then speeded up by depressing the accelerator. The bus gains speed, and when it has attained the usual top-gear speed, the accelerator pedal is slightly released and the control lever is pulled back into the direct-drive position. Thereafter the road speed is controlled by the accelerator in the usual way.

When desiring to stop, the driver pushes the control lever forward and then stops the vehicle by means of the brakes. To restart, he releases the hand brake, presses the accelerator pedal until top-gear speed is reached, and then again pulls the control lever back.

The Leyland hydraulic torque converter is made for both buses and rail cars. The rail-car type differs from the bus type here described in that the reversing gear is not combined with the converter, but is mounted on the axle of the car.

Investigation Is Not Research

IN an article in *Engineering*, W. Nelson Elgood makes the assertion that there is a need for delimiting the boundary between research work and experimental investigatory work. There is, he says, an unfortunate tendency to label all investigatory work research work, with resulting confusion.

Both the research worker and the experimental investigator must have equally high standards of skill, technical knowledge, and observation abilities, but in the process of inference by logical methods the required standard of mental ability to argue varies. This does not necessarily mean that one class of worker is better endowed with mental abilities than the other; rather does it imply that one worker may have to make a higher mental effort to reach his conclusions than the other. Both workers in their work infer conclusions after processes of observation, but it is in the conclusion reached during the logical methods following observation that their work must differ.

The process of inference is readily divided into two main methods of logical argument, viz., induction and deduction. By induction the investigator determines order from the phenomena or sequence of events observed, and thereafter he establishes the necessary covering laws. By deduction the investigator applies to the results of his process of observation hypotheses or laws previously determined by inductive methods following experimental work undertaken by himself or some other investigator. There is a definite difference between results obtained by inductive methods and those obtained by deduction.

The kinds of results obtained in investigatory work must give a clue to the classification of the work undertaken. Work which give results obtained by a process of induction based on results obtained from a process of observation is undoubtedly research work, while work which gives results obtained by deduction based on results of observation is experimental investigatory work.

Research work is often regarded as a theoretical investigation and experimental investigatory work as a practical investigation. These views may not be strictly true, but they indicate the place the respective inferred results take in practice. There is no reason why a research worker should be regarded as a non-practical man and an experimental investigator as a practical man, but in general the results obtained by the former are required for the establishment of theories and those of the latter for giving information required in the practice of engineering.

500 Ring Wings Broached Per Hour

Broach developed by Houde Engineering Corp. turns out 20,000 pieces between sharpenings

by Joseph Geschelin
Engineering Editor, Automotive Industries

HOUDE Engineering Corporation is very proud of a particularly difficult broaching operation distinguished by a broach of unique design which has attracted much favorable comment. The workpiece is a Ring Wing of malleable cast iron, Fig. 1, requiring a broaching finish of the two wide arcs on the large diameter and the two small segments of minor diameter.

Broaching is performed in two steps, rough and finish, from the rough casting. Roughing is done on a single-spindle vertical broaching machine handling three rings, 7/8 in. wide, at a time. Finishing is done in a two-spindle horizontal machine with each broach handling only one ring at a time.

Fig. 2 is a view of the roughing operation on a type PM vertical Oilgear broach with a 5 hp. drive, taking three rings at a time as shown. One man runs the machine, producing 500 pieces per hour. About 11,000 pounds pull is required when broaching two rings while 15,000 pounds pull is needed for three at a time.

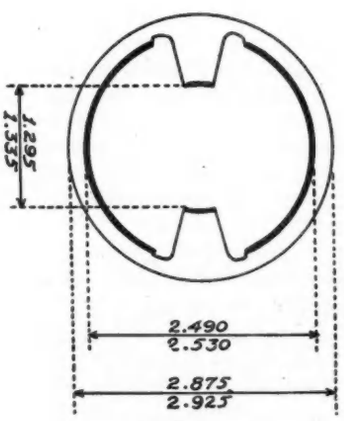


Fig. 1—Drawing of Ring Wing showing the internal segments (heavy arcs) which are roughed and finished by broaching

The rough casting has the diameters held at 2.505-2.465 in. and 1.170-1.210 in. respectively. These are opened up in the roughing operation to 2.520 and 1.200 in.

For finishing the process shifts to the type XB10 horizontal Oilgear machine, Fig. 3, driven by a 15 hp. motor. Two broaches are used, each handling one range; both broaches cut at the same time and return together to the loading position. This operation opens the two internal diameters to 2.5645 and 1.251 in. respectively from the previously roughed surfaces. The tolerance on diameter is ± 0.001 in. Depth of cut on the large diameter is 0.022 in., on the small diameter, 0.025 in.

Two men operate one machine, each man handling one broach. The output of the machine is 500 rings per hour. About 9,500 pounds pull is required per stroke.

Since tool life as well as the quality of finish is so dependent upon the right kind of cutting fluid, both roughing and finishing set-ups are treated to a copious bath of a mixture adopted in this plant. It is compounded by adding 7 gal. of No. 2 Cutlite broaching oil to 55 gal. of paraffin oil.

Coming to the details of the broach we show in Fig. 4 the type of tool used for both roughing and finishing. This illustration gives in fine detail the general arrangement of the broach particularly the method of aligning the discs by means of the bar which is passed through the drilled holes and keyed in both the entering and back pilots. Note that the small cutter is piloted as an integral part of the large disc.

The rough broach used for the operation in Fig. 2 has 20 cutting discs each 3/8 in. thick for the large diameters and 20 cutting discs each 5/32 in. thick for the small diameter. The discs are made from high-speed steel, each disc having one cutting edge. The discs are sharpened to the following diameters:

1	2.450 in. and 1.140 in.
2	2.460 in. and 1.140 in.
3	2.470 in. and 1.150 in.
4	2.475 in. and 1.160 in.
5	2.480 in. and 1.164 in.
6	2.484 in. and 1.168 in.
7	2.487 in. and 1.172 in.
8	2.490 in. and 1.176 in.
9	2.493 in. and 1.180 in.
10	2.496 in. and 1.184 in.
11	2.499 in. and 1.187 in.
12	2.502 in. and 1.190 in.
13	2.505 in. and 1.192 in.
14	2.508 in. and 1.194 in.
15	2.511 in. and 1.196 in.
16	2.514 in. and 1.196 in.
17	2.517 in. and 1.198 in.
18	2.519 in. and 1.199 in.
19 & 20	2.520 in. and 1.200 in.

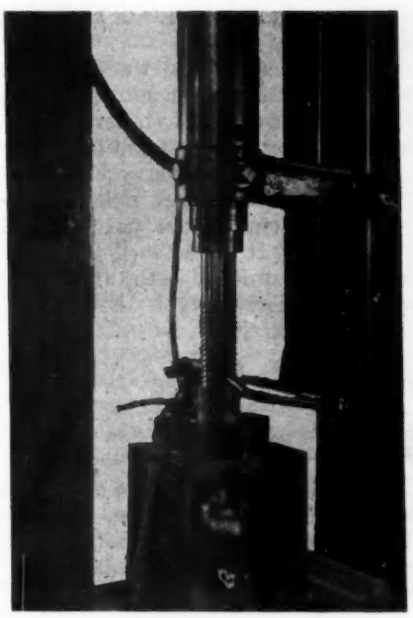


Fig. 2—Roughing is done on a single spindle Oilgear broaching machine, three rings being handled at a time. Production is 500 pieces per hour with one operator

The front pilot on the roughing broach is 2.430 in. diameter; the back pilot, 2.518 in. diameter. Four of the discs are discarded each sharpening. Approximately 25,000 pieces are broached for each sharpening.

The finishing broach has 52 discs for each of the two diameters, the six largest discs for the large diameter having two cutting edges each. After each sharpening six of the discs are discarded and replaced by new ones. Approximately 20,000 pieces are broached for each sharpening. The entering pilot is 2,500 in. in diameter, the back pilot 2.5635 in.

Surface speed of the finishing broach is 20 ft. per min.; for the roughing broach, 24 ft. per min.

We are told by manufacturing officials of the company that this process has occasioned much favorable comment on the part of tool designers. It is believed that this set-up is unique both from the point of view of tool performance and productivity.

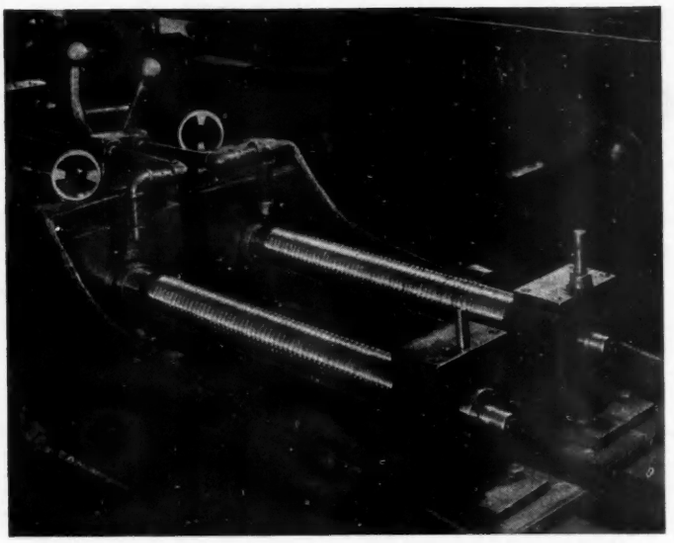


Fig. 3—Finishing is done in a horizontal Oilgear machine handling one ring per broach. Two operators are required, one per broach, the output being 500 pieces per hour to balance the roughing operation

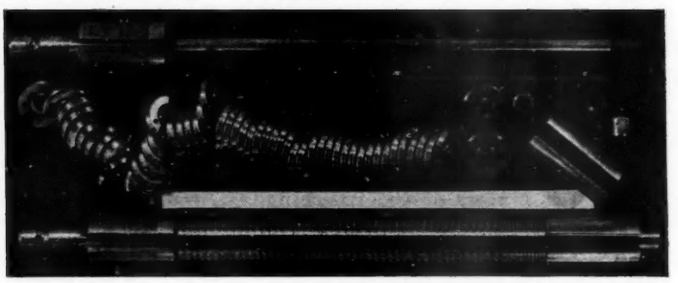


Fig. 4—This shows the type of broach used for both rough and finish operation. The roughing broach has 20 sets of cutting discs, the finishing broach, 52 sets

Spring Testing With Photoelectric Relay

The Material Division, U. S. Army Air Corp., Wright Field, Dayton, Ohio, uses an old punch press as a fatigue testing machine for shock absorber springs. The equipment operates twenty-four hours a day and a small counter indicates the number of times the spring is compressed. In the past, the difficulty was that the spring might break during the night, and since the machine would continue to operate, it would record an incorrect number of compressions on the counter.

The problem was solved by installing a General Electric photoelectric relay in such a position that the light beam passes beneath the bottom of the plunger when the plunger is in its lowest position. In this arrangement, the spring intercepts the light beam and prevents its from falling upon the phototube under ordinary circumstances. When the spring breaks, however, it collapses and the beam passes over it to the phototube which actuates a relay to stop the machine.

Chevrolet Main Shafts Being Lead Hardened

Chevrolet Motor Co. has just installed a continuous lead hardening machine, designed and built by Surface Combustion Corp., Toledo, Ohio. This machine is used for hardening transmission main shafts. The machine consists of a loading station, preheat chamber, a lead pot, an oil quench, a drip station, a washing station and an unloading station. The entire hardening operation is mechanically operated, with only the assistance of one operator in the whole process.

The work is hung on suitable alloy hangers and is conveyed by means of central vertical mast to which six arms are attached. Raising is accomplished by means of an air cylinder which moves the arms upward, and by means of another cylinder the arms rotate 60 deg. to a new position. Gravity takes care of the downward movement.

Equipped with Centrifuse

INFORMATION received from the Chrysler engineering department indicates that production models of the DeSoto and Chrysler lines as well as the Plymouth Deluxe Six will be equipped with Centrifuse drums in place of the cast iron types indicated in the specifications accompanying the car announcements, written from data on experimental models.

New Process Cleans Cold-Rolled Steel Parts without Hand-Wiping or Tumbling

by C. Johnson
Technical Director, Oakite Products, Inc.

THE cleaning of cold rolled steel before finishing presents an unusual type of problem because this type of stock almost always carries a light coating of mineral oil for anti-rusting which also holds varying amounts of dirt. The dirt consists of minute particles of carbon liberated from the steel or scale in pickling the steel before cold rolling, atmospheric dust picked up by the oil film and also minute steel chips formed in rolling and trimming the sheet or strip.

Conventional methods of cleaning without wiping or tumbling the parts satisfactorily remove the anti-rust oil but do not remove the dirt particles, finger marks and smudges formed in handling the parts. As a result of prolonged investigation a new process (*patent applied for*) has been perfected which makes it possible to clean parts manufactured from cold rolled steel stock without wiping by hand or tumbling in sawdust or other absorbent. This process is extremely simple in operation and has proved practical under actual operating conditions in a number of manufacturing plants.

The process consists of applying a special solvent to the metal parts by dipping or spraying. From 15 to 30 seconds' exposure to the cold solvent is sufficient for most cases. This operation is followed by rinsing with cold water. These operations can be carried out in any of the standard types of equipment after a few minor changes have been made. Owing to characteristics peculiar to the solvent the dirt particles are loosened and washed away in the rinsing operation. The success of the method depends upon the fact that the above procedure temporarily wets the dirt particles with water without removing more than the excess oil from the steel leaving a light but uniformly distributed film of oil over the entire surface. Because the dirt particles are wet with water and the surface of the steel is still wet with oil, the adhesion of the dirt particles is overcome and they are washed away. On certain types of stock further rinsing produces a surface which is almost entirely free of oil as well as dirt.

The third step of the process consists of removing the light film of oil which usually remains by any conventional method of cleaning. Another recently perfected Oakite cleaner accomplishes the third step by 60 seconds' immersion in a hot solution without the use of electric current.

Because the process is independent of the use of electric current, it is effective on recessed areas as well as on exposed areas. It is also as effective on small parts cleaned in bulk before barrel plating as for larger parts racked individually for plating.

The process can be made entirely automatic and on continuous systems the increased speed of cleaning has a decided advantage. Because the first two operations are carried out cold there is a considerable saving in fuel for heating large soaking tanks often used for preliminary cleaning. The new process furthermore accomplishes results which soaking baths do not.

The process is applicable to cleaning of cold rolled steel and any other metal or alloy carrying similar deposits, as the solvent has no corrosive action on any metal or alloy. It is being successfully used in cleaning before plating, lacquering and painting.

The solvent is not inflammable and does not give off toxic vapors. Losses by evaporation are negligible even when it is used in open tanks. The only loss of solvent is that carried out on the surface of the parts and this is reduced to a minimum by permitting a short draining period. For the average run of oily and dirty steel the solvent may be used indefinitely if fresh solvent is added to replace the losses by drag out.

The process is not recommended for removing carbonized oil and scale residues formed when the parts have been annealed or heat treated in the process of manufacture. Such deposits are entirely different from the deposits for which the process is intended and are usually so tenacious that hand wiping or even wire brushing will not completely remove them. Within the special field for which the process is intended the following advantages have been observed under actual operating conditions.

1. Eliminating of all hand wiping or tumbling operations previously required to remove dirt particles, finger prints, etc.
2. Elimination of irregularities in the electroplate, lacquer, or enamel finish.
3. Brighter finish of electroplated deposits especially on cadmium.
4. Better coverage especially in recessed areas.
5. Improved adhesion of electroplating.
6. Improved corrosion resistance of electroplated surfaces.
7. Increased speed in cleaning.

In addition to removing dirt from cold rolled steel, the process is effective for removing polishing and buffing compositions from all the metals and alloys and for removing white lead and other pigmented drawing compounds which are not satisfactorily removed without brushing by any other cleaning process.

With Gas

According to the dope at a recent Met. Section meeting, the Stout Railplane is driven by two Waukesha engines, each of 165 hp. capacity. Incidentally, this car is fabricated by acetylene welding following aircraft practice in building the tubular structure. No place for oil or grease fittings on the running gear as all joints are of rubber in shear or compression.

JUST AMONG OURSELVES

No Halfway Opinions On Streamlining

THE eyes of the industry, without a doubt, will be on the radical Chryslers and DeSotos for the next few months. So far the one certain thing is that the startling appearance of these cars has everybody talking. Public opinion has scarcely set itself yet, but more than one personal interview survey is under way which includes questions specifically on these cars or the design trend which they exemplify so strongly.

Some people, we find, like the type of design exemplified by these two new cars; some dislike it strongly. We have yet to find anybody who is indifferent. Everybody has an opinion. Our purely personal opinion is that the cars will click; increasingly so as ride-experiences are added to visual observations. We had our first ride in a Chrysler Imperial just a few days ago.

Sales records will tell the final story on this type of design, of course. Several months must elapse before those are available; the Chryslers and DeSotos, we understand, will just be getting into production early in February.

* * *

Delivered Price Idea Gets Big Boost

DESIRABILITY of advertised delivered prices on automobiles gets more apparent every day. The current battle to achieve f.o.b. lists lower than competitors in the face of necessary increases has enhanced, in some cases, the tendency to exclude from the f.o.b. little more than a chassis, a body and an engine.

A salesman almost ran out of breath the other day trying to answer specifically and honestly our question: "What accounts for the $300 spread between the price for which this car is advertised and the price you ask me to pay?"

Definite efforts to decrease the spread have taken place recently in some lines, to be sure, but with prices going up and competition getting keener, strong pressure exists toward pricing on the basis of stripped cars which nobody could or would buy.

Practically every manufacturer in the business today favors advertised delivered prices. The public deserves this service. General action is needed in 1934 either through code compulsion or common agreement.

* * *

Used Car Allowances And Dealers' Discounts

THINGS move fast in the automobile business. Only six weeks ago a large proportion of the sales executives of the industry told us that they didn't think the standardized used car allowance would affect dealer discounts for some time to come, even though a downward movement eventually obviously was indicated.

The downward movement is coming sooner rather than later, we now are convinced. In more than one case it already has come. While there has been no big slashes in dealer discounts, the general curve is in the process of dipping slightly right this moment.

* * *

What Will Be Done About the Tax on Gas?

A FIGHTING chance still exists of getting the automobile excise tax removed at this session of Congress, according to expert Washington opinion obtained by our own ear-to-the-ground-department. That constitutes an optimistic rumor, so far as we were concerned. Here's hoping.

Despite courageous and intelligent opposition of the petroleum industry to the Federal gas tax, there seems to be little if any chance of removal of that levy this year. Hard fighting probably will be necessary, in fact, to keep the extra half-cent (recently removed) from being put back on. Trouble is that Congress—like the States—finds the gas tax easier to collect than some others. When that is the case logic and justice too often fly out the window.

Decline in gasoline consumption and in car registrations almost certainly can be traced partially to the terrific increases in gasoline taxes in recent years. Taxing bodies are well on their way to killing the goose that lays the golden eggs. The rising gas tax tide must be stemmed if the public interest is to be protected.
—N. G. S.

PRODUCTION LINES

40 Sheep

A visit to the Packard Color and Fabric Salon in New York during Show week was indeed a revelation. Minerals, color devices and other scientific exhibits were there. Also the Bausch & Lomb spectrograph—the largest made—and a B & L color analyzer all set up so the public may see what they are for. It takes 40 prize sheep chosen from three select flocks to make the broadcloth for a Packard, only a pound of the wool of each shearing being used. Teazel, a plant with tough, wiry spines, is what gives this cloth its beautiful, silky nap.

X-Ray Tells

L. Thomassen and D. M. McCutcheon of the University of Michigan described at the Annual meeting of the ASME., a technique of X-Ray measurement of depth of cold work by machining. Among other things they conclude that: "Depth of cold working increases more rapidly with increase in feed than with increase in depth of cut, for the tools and materials used. In milling, a doubling of the feed from 0.007 in. to 0.014 in. increases the depth of working from about 0.006 in. to 0.0085 in., or about 40 per cent, while a doubling in the depth of cut from 0.016 in. to 0.032 in. increases the depth of cold work from 0.0039 in. to 0.0046 in., or about 20 per cent. For the turning operations, a doubling of the feed from 0.010 in. to 0.020 in. increases the depth of cold working from 0.011 in. to 0.0165 in., or 50 per cent, while the corresponding increase in feed only brings about an increase in depth of cold work from 0.006 in. to 0.0085 in., or 25 per cent."

Off the Griddle

A large Eastern university has been working for a long time on the development of a small, high-powered diesel engine using rotary valves. It is claimed that an engine of relatively small displacement has yielded an output of 125 hp. We learn that this project is backed financially by one of the older machine tool builders.

Rear Driven

Some engineers believe that with rear engine drive the passengers will freeze in cold weather. May we hear from those who have given the design a try. There must be some way to get heat up forward. And if there is, another mental hazard will have been dispelled.

Cylinder Bores

Editor AUTOMOTIVE INDUSTRIES:

The writer noticed in the Aug. 5 issue of your magazine an article dealing with corrosion wear in gasoline engine cylinders.

In this article we were impressed with the inaccuracy of remarks in regard to chromium plating attributed to E. C. Ottaway, to the effect that it was impossible to get a uniform deposit with a light coating of chromium, and also that the deposit can not be applied heavy enough to allow for grinding.

We have successfully plated a number of cylinders with coatings of approximately 0.0005 in. to a degree of accuracy of out-of-round which was much less than that of the original grind. It is also possible and commercial to deposit coatings of chromium thick enough to be ground and leave a thickness of from 0.002 to 0.010 in. after the grinding operation.

There is no doubt in the writer's mind that eventually one or the other of these will be done, at least on the higher-priced cars. From actual experiments we find that it increases the life of the rings, reduces the friction and maintains high compression over a longer length of use.—A. R. D.

Hardware Notes

Nothing has been done about concealed door hinges and recessed outside hardware. Seems like enough had been said about streamlined door handles to arouse our interest. But in many cases said handles, although indeed streamlined, unfortunately face the wrong way, sharp point to the front.

Scale Free

Motor Wheel Corporation is installing a Surface Combustion Continuous Bright Annealing Furnace. This is a muffle type unit with a walking beam mechanism for conveying the work through the furnace and is used for annealing artillery type wheels. The operation will give a scale free product, eliminate heavy pickling costs and improve quality.—J. G.

MANUFACTURING MANAGEMENT METALLURGY

NEW DEVELOPMENTS

Automotive Parts, Accessories and Production Tools

Continuous Automatic Surface Broaching

The Foote-Burt Company, Cleveland, Ohio, which has pioneered in the art of surface broaching, announces a new type of surface broaching machine. This machine is an addition to their regular line of vertical type machines which they have manufactured for the past seven years and offers its principal advantage where extremely high production is required.

The motor is connected directly to a work shaft, power being transmitted through this worm and worm gear then through helical gear reduction to the driving sprocket.

The chain wraps around the driving sprocket and idler sprocket and is very accurately constructed as the work holding fixtures are assembled directly to the chain. The number of fixtures furnished with each size machine is governed by the production desired and the size of the work to be operated upon. The fixtures are always placed equidistant about the chain for convenience for loading.

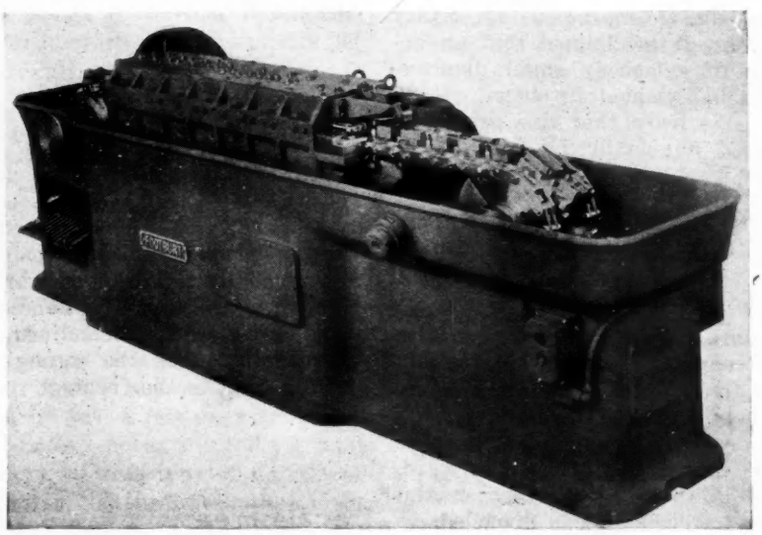
The fixture tunnel is mounted on top of the bed of the machine and where the fixtures ride in the tunnel, tool steel guides are provided. The broach holder is made with adjustable wedges which provide an easy method of setting the broaches to the cut; also to compensate for the amount of metal removed when the broaches are reground. The fixtures are usually of the automatic clamping type and the operator merely drops the work into the fixtures where a cam guide equalizes the work in proper position at the point where the fixture is automatically locked by the means of a built up pressure from a trip hammer blow.

The illustration shows the front and end view of the machine which is the operator's loading position. The fixture exposed is for holding a connecting rod cap and the cap is placed in the fixture where it will rest upon the two steel buttons which contact the two back bolt bosses. The fixture is of the vise type, the drive side of the jaw being the solid part of the fixture and acts as a heavy anvil support to the work, while the other jaw, which is movable, is actuated by a wedge with a fast angle followed by a slow angle for locking the cap sidewise securely.

This type machine lends itself exceptionally well for an unusually long broach, which provides many teeth for removing the metal, and makes almost any desired quality of finish. Slow cutting speeds also contribute to economical broach life, as the tool cutting speed on this Cap Machine is only 25 cutting feet per minute. The broach will average about 50,000 cuts per grind.

The connecting rod cap operation shown is a tough forging with about 3/16-in. metal removed from the two joint faces and the two outer end surfaces. The finish is smooth and the production is 1800 pieces per hour.

These machine are available in three sizes; No. 5 with a capacity of 5 hp., a maximum broach length 30-in.; No. 10 machine, capacity 10 hp., maximum broach length 60-in., and No. 15 machine, capacity 20 hp., broach length 75-in.



Foote-Burt Continuous Automatic Surface Broacher

Electrode for Welding Cast Iron Announced by Lincoln

An electrode for welding cast iron by the shielded arc process is announced by The Lincoln Electric Company, Cleveland, Ohio. The electrode, known as "Ferroweld" is said not only to simplify welding procedure on cast iron but to produce a weld with greater strength and ductility than the cast iron.

"Ferroweld" has a steel core surrounded by a heavy flux coating which protects the arc from gases injurious to the weld which are present in the atmosphere. It is made in only one size, ⅛-in., and is used with approximately 80 amperes of current.

Welding is done intermittently, not over a three-inch bead being laid down at one time. As each bead is welded it is peened lightly, thoroughly cleaned and allowed to cool somewhat before the next bead is deposited. Due to the extremely low current with which it is used the hardening effect ordinarily present along the line of fusion is materially reduced. Thus the weld is said to be more machinable than most cast iron welds.

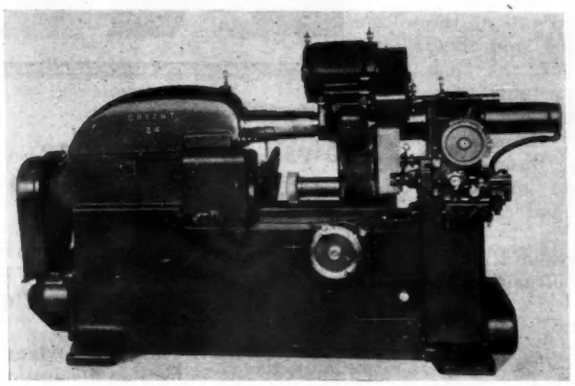
Internal Grinder for Variety of Work

A heavy duty production internal grinder for a wide variety of large work has been announced by the Bryant Chucking Grinder Co., Springfield, Vt. The No. 24 Internal grinder is said to provide a new standard of finish which makes it particularly suited for the finishing of aircraft cylinders, crankcases, propeller hubs, brake drums, differential carriers, truck wheel hubs, etc.

The machine is semi-automatic, fully hydraulic in operation, the diamond holder, cross feed and wheel slide lifter being controlled and operated hydraulically, in addition to the traversing of the wheel slide.

NEW DEVELOPMENTS
Automotive Parts, Accessories and Production Tools

These various units are interlocked so that the operator has complete control over all motions by means of one simple lever. The work spindle starts and stops automatically tied in with the motion of the wheel slide. That is, when the wheel slide is withdrawn from the grinding position to the right of the stroke, the work stops rotating. When the slide is advanced again toward the left toward grinding position the work automatically starts again.



Bryant Heavy Duty Chucking Grinder For Varied Work

Swing is available in two sizes, 21 and 31 in. in diameter. The grinding stroke is 14 in. R.p.m. of work spindle depends upon the type of motor—with a four speed AC motor, speed range is 100, 150, 200, and 300 r.p.m.; with a variable speed DC motor, speed range is from 60 to 250 r.p.m.

Motor equipment is as follows: wheel drive—10, 15 or 20 hp.; work drive—3 hp.; oil pump—2 hp. 1200 r.p.m.

Net weight, 13,000 and 13,500 lb.

A New Société Genevoise Jig Borer

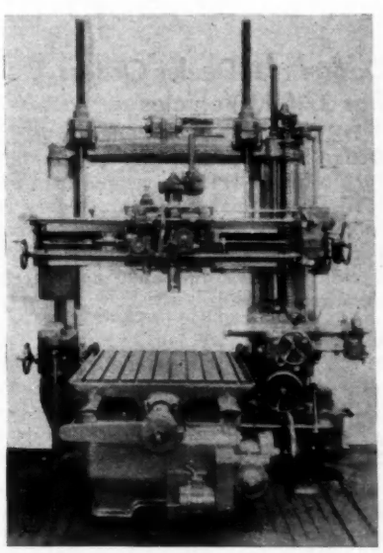
A large jig borer, with two vertical and one horizontal boring heads, has been developed by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, and is being marketed in America by the R. Y. Ferner Co., Washington, D. C.

The machine has a work table of 59 x 40½ inches, which is moved by motor or by hand through 52 inches by a micrometer lead screw. The micrometer head on this screw, as well as the others of the machine, is 7½ inches in diameter and is read by vernier to 0.00005 inches.

The two vertical boring heads are mounted on a slide on the cross rails and have 40 inches motion across the table. The main spindle has 10 inches travel feed and 3 rates of power feed, and will drill holes in cast iron 2 inches in diameter or bore with single point tool up to 6 inches. It has nine speeds from 48 to 420 r.p.m. The other vertical spindle, exactly 8 inches from the first and parallel to it, has a Morse Cone No. 2 and a range of speeds from 140 to 1250 r.p.m. The cross rail can be raised from a minimum distance between table and spindle nose of 16 inches to 36½ inches above the table. A ½-hp. motor is provided for raising and lowering the cross rail. The two vertical columns of the machine are 55 inches apart.

The third boring head, horizontal, is mounted on the right column and is accurately counterpoised by a weight moving within a well in the rear of the column. It has 20½ inch vertical movement, from 8 inches above the table to 28½ inches. The spindle has a Morse Cone No. 4 and has 12-inch feed travel, with power feeds and 9 speeds the same as the main vertical spindle. All three spindles have individual lubricating pumps of a type developed by the Société Genevoise.

Opposite the horizontal spindle is an adjustable guide for a boring bar to be held in the horizontal spindle for the simultaneous boring of two holes in the same axis when the job is too big to be mounted on the 31½ inch circular table furnished with the machine. An ingenious device for accurately aligning this guide for the boring bar with the axis of the spindle is supplied.



Société Genevoise Jig Borer

Streamlined Electric Drill

The Black & Decker Mfg. Co., Towson, Md., has announced a new ½-in. special ball-bearing electric drill. The design is streamline from "stem to stern," and with the weight so distributed as to give good balance, the drill is said to be one of the easiest to handle.

This new drill has a no-load speed of 400 r.p.m. and weighs 13¼ lb.

Flexibility Features Swing Frame Grinder

The Lectrogrinder, a rapid-type, swing-frame grinder, has been placed on the market by the Pittsburgh Engineering Works, Pittsburgh, Pa. It is designed to be hung on any form of crane or trolley support, the hanger being fully adjustable for balance, allowing the desired proportion of the weight to hang normally on the wheel. The grinder may be turned 90 deg. on its side when it is required. The wheel spindle has four roller bearings.

Wheel centers are of steel and arranged with adjustable balancing weights so that should the wheel become out of balance it may readily and properly be rebalanced without removing the wheel from the shaft.

Decision Withheld By Compliance Board After Hearing Arguments in Budd Case

E. G. Budd Reads Strong Statement on Company's Position in Denying Charges of Coercion Filed by Labor Unions

WASHINGTON — The hearing of the case against the E. G. Budd Manufacturing Company before the National Compliance Board on Wednesday ended without definite action beyond the expression of a hope by Chairman William H. Davis of the Board that an agreement may be reached for the holding of another election to determine whether the employees of the company desire to be represented in collective bargaining by the company's employees' organization or by an outside union. In closing the meeting Mr. Davis said, "I suggest adjournment with the idea of studying the testimony offered today and with the hope of reaching some agreed settlement." He had said previously that if such an agreement could not be reached outside the hearing, the hearing must be resumed probably after an investigation conducted in Philadelphia.

Nothing really new came out at the hearing. The positions of both the company and the union representatives were maintained without evidence of compromise.

The hearing was largely attended by officials and employees of the company and by spokesmen for the American Federation of Labor and the United Automobile Workers which is not affiliated with the A. F. of L. Representatives of other NRA boards also sat in.

The hearing followed a long series of developments originating in charges filed by the United Workers Federal Union No. 18763, alleging interference by the company in the organizing of its employees and their election of delegates for collective bargaining. A hearing was given by the National Labor Board on Dec. 14, 1933, and as an outcome of that hearing the case was transferred to the National Compliance Board for further action. The labor board reported at the time that its efforts to mediate the labor dispute between the company and its employees and to obtain compliance with its desires had been unavailing.

The meeting Wednesday before the National Compliance Board was held, according to Chairman Davis, as an administrative fact-finding proceeding for the determination of subsequent action by the Administrator on the charge of non-compliance with the automobile code. "Neither the National Compliance Director nor the Administrator has any law enforcement power. This hearing is to determine first whether there has been any violation of the code. That involves a question of whether the Blue Eagle shall be removed and the further question of whether the case is one which should be referred to the law enforcement agencies of the Government, the Federal Trade Commission or the Attorney General."

Chairman Pierre S. duPont, of the Industrial Advisory Board said that, speaking only for himself, the case was not presented in accordance with the views of all of the members of the National Labor Board. He said it was doubtful whether the Budd Company, in reference to the employees' representatives election, had actually violated the N.I.R.A.

Joseph N. Ritchie, representative of

(*Turn to page 119, please*)

Chevrolet Retail Orders Exceed 50,000 Mark

DETROIT—More than 50,000 retail orders from purchasers for immediate delivery are in the hands of Chevrolet sales officials, according to William E. Holler, general sales manager of the company. Production of the 1934 cars is well under way and the company has sufficient orders on hands from dealers to insure maximum production for several months.

Actual attendance at the first 60 showings, which embraced cities in eastern and middle-western parts of the country, totaled 3,528,644. When final attendance figures from the showings now being held are tabulated, it is estimated that more than 5,000,000 people will have visited the special exhibits.

Dodge Has Dealer Orders For 32,000 Vehicles

DETROIT — Retail deliveries of Dodge cars between January 1st and 20th totalled 3772 passenger cars and 1515 commercial vehicles. Orders received from dealers during the same period call for shipment of 27,200 passenger cars and 5000 commercial cars and trucks.

Fisher Resigns From G.M. Executive Comm.

DETROIT—Fred J. Fisher has resigned from the executive committee of General Motors Corporation. He remains a director and member of finance committee.

NEW

Shows Give Evidence Of Business Revival

Heavy Gains in Attendance and Orders Revealed by Reports From Leading Cities

NEW YORK—Tangible evidence of improvement in business conditions throughout the country is presented in reports received by the National Automobile Chamber of Commerce on the success of automobile shows which have been held in various key cities.

Without exception, nine cities which have held motor shows since the new 1934 models made their debut at the New York Show in Grand Central Palace to a gate 63 per cent above last year, report substantial gains in attendance, orders and buying.

Attendance at the Philadelphia Show was 37 per cent above 1933. Actual sales, according to a survey made by W. P. Berrien, manager, covering 60 per cent of the exhibitions were 3½ times the number transacted last year. "Our dealers are greatly encouraged over the public's evident determination to spend money again," Mr. Berrien declared.

Even more phenomenal was the success of the Milwaukee Show where day-by-day paid attendance showed increases of from 92 to 298 per cent over last year.

In the metropolitan area Harry Bragg, manager of the New York Automobile Merchants Association and Ralph Ebbert, manager of the Brooklyn Motor Vehicle Dealers Association, both report that actual sales and requests for demonstrations from prospective purchasers are running away ahead of last year. The principal problem of many dealers, they say, is to satisfy orders for early delivery.

Patrons at his Show in Newark last week were no longer raising the once-familiar question, "What will we use for money?" Claude E. Holgate, secretary-manager of the Show, reported.

Excellent reports are also in from Cincinnati, St. Louis, Cleveland and Toronto.

WS

Progress in Marine Engine Design Demonstrated at Motor Boat Show

Many Diesels Ranging in Capacity from 6 to 600 Horsepower Are Exhibited. Large Attendance Promises Buying Revival

by P. M. Heldt

Engineering Editor, Automotive Industries

NEW YORK—Three floors of the Grand Central Palace this week are filled with exhibits of motorboats, marine engines and motorboat accessories, making up the twenty-ninth annual national motor boat show being held here under the auspices of the National Association of Engine and Boat Manufacturers.

Nearly all of the space on the main floor is occupied by exhibits of motor boats, a large number of cabin boats being shown. On the mezzanine floor exhibits of marine engines predominate, while the third floor is given over to exhibits of motor boat accessories of all kinds. Surplus space on the two upper floors is devoted to educational exhibits relating to subjects of interest to motor boatists.

Numerous different engine models are on display, covering an immense range of output, from the single-cylinder outboard engine of only about 5 cu. in. displacement, to the large multi-cylinder Diesel of about 4,000 cu. in. displacement and 600 hp. output. One of the reasons for the multiplicity of models seems to be that in the marine field, types and practices do not become obsolete as quickly as in the automobile industry. Thus we still find multi-cylinder marine engines with individually cast cylinders and with T heads.

Diesel engines are becoming a more important factor in motorboat work, which is not surprising in view of the facts that boat engines usually run under nearly constant load, an operating condition particularly favorable to the Diesel, and that elimination of fire hazards through the use of heavy fuel adds to the safety afloat. Diesel engines of the following makes are being exhibited at the show: Ailsa Craig, Atlas-Imperial, Bolinders, Buda, Fairbanks-Morse, Hercules, Hill, Red Wing, Speedway, Sterling, and Winton.

Much attention is centered on the new Sterling Diesel engine, which is built under Michell patents and involves the use of two swashplates instead of a crank and connecting rods. It is a two-stroke-cycle engine of four-cylinders, with two opposed pistons in each cylinder, the explosion taking place between them. At one end of the engine there are four scavenging pump cylinders, the pistons in which are connected by piston rods and yokes to the working pistons on that end. The engines shown have a bore of 3½ in., and the stroke of each piston is

(*Turn to page 118, please*)

Auburn Will Have Radical New Model

AUBURN, IND.—In issuing the report of the Auburn Automobile Company and its subsidiaries for the fiscal year ending Nov. 30, 1933, E. L. Cord, chairman of the board, said, "During the present year we will introduce still another new car of radically advanced design, engineering and performance. This car will be introduced under a new name and will offer the possibilities of a larger market and greater profits for the company.

The report showed a consolidated net loss of $2,307,972, including depreciation amounting to $592,500. In the corresponding 12 months' period of 1932, the consolidated net loss was $974,751.

The consolidated balance sheet as of Nov. 30, 1933, reflects total current assets of the company and its subsidiaries amounting to $8,548,601 as against total current liabilities of $618,443.

2,025,125 Motor Vehicles Produced in U. S. and Canada in 1933

WASHINGTON—December, 1933, production of motor vehicles in the United States and Canada amounted to 87,307 as against 66,195 in November and 109,492 in December, 1932. This is a decrease from last December of 20.2 per cent but shows an increase over November of this year of 32 per cent.

Of the motor vehicles produced during December in the United States and Canada 56,071 were passenger cars, while 31,236 were trucks. Passenger car production for the month showed a decline from a year ago, but trucks made the substantial gain of 43.5 per cent in the same period.

During the year 2,025,125 motor vehicles were produced in the United States and Canada as against 1,431,494 during 1932. Of this number 1,660,558 were passenger cars and 364,567 were trucks. Last year only 1,186,209 passenger cars were produced and 245,285 trucks were manufactured. Total production for 1933 shows an increase of 41.5 per cent over 1932, with passenger cars having an increase of 40 per cent and trucks a gain of 48.9 per cent.

United States production for the year amounted to 1,959,201 as against 1,370,678 during 1932, a gain of 43 per cent. Canadian production for the same period totalled 65,924 as compared with 60,816 in 1932, a gain of 8.3 per cent.

A comparative summary follows:

	Total	Cars	Trucks
12 months, 1933	2,025,125	1,660,558	364,567
12 months, 1932	1,431,494	1,186,209	245,285
December, 1933	87,307	56,071	31,236
November, 1933	66,195	45,932	20,263
December, 1932	109,492	87,710	21,782

G.M. Overseas Sales Up 56% Over 1932

NEW YORK—General Motors sales in overseas markets for the full year 1933, from all sources, totaled 121,662 units, an increase of 56 per cent over the total for 1932. Since March, the gains over corresponding months in the previous years have become increasingly greater, and during the last quarter of 1933 alone, the volume has been running far ahead not only of 1932, but of 1931 and 1930 as well.

Overseas car and truck sales of the corporation for the complete year 1933, indicate a recovery in automotive consumption abroad which extends, with minor exceptions, to all of the 104 export markets throughout the world. The increases in General Motors business overseas extend not only to the products of the corporation manufactured in the United States and Canada, but also to the Opel product manufactured in Germany, and the Vauxhall product manufactured in England.

Business in Brief

Written by the Guaranty Trust Co., New York, exclusively for Automotive Industries

The improvement in general business continued last week, but at a slower rate. However, the volume of retail sales was well maintained; and wholesale demand increased. The major industries were all operating at higher levels than at the corresponding time last year. A better showing was made in steel production, car loadings, and electric power production.

Car Loading Up

Railway freight loadings during the week ended Jan. 13, totaled 555,627 cars, which marks an increase of 55,688 cars above those during the preceding week, an increase of 45,734 cars above those a year ago, but a decrease of 17,022 cars below those two years ago.

Oil Production Up

Average daily crude oil production for the week ended Jan. 13, amounted to 2,311,250 barrels, as against 2,165,950 barrels for the preceding week and 2,011,150 barrels a year ago.

Construction Up

Construction contracts awarded in 37 eastern states during December, according to the F. W. Dodge Corporation, amounted to $207,209,500, as against $81,219,300 in the corresponding period last year. Of the December contract total $155,862,800 was for public construction, while the remainder was for privately financed undertakings.

Cost of Living Up

According to the Department of Labor, the cost of living for families of wage earners increased 5.2 per cent. During the six months' period ended December. The cost of every group of items used in the calculations increased excepting rents.

Wholesale Index Up

Professor Fisher's index of wholesale commodity prices during the week ended Jan. 20, stood at 72.1, as against 72.0 for both the week and two weeks before.

Power Production Up

Production of electricity by the electric light and power industry in the United States during the week ended Jan. 13, was 10.1 per cent above that a year ago.

But Cotton Goes Down

Cotton consumed in the United States during December amounted to 400,017 bales, including linters, as against 440,439 bales in the preceding month and 488,507 bales in the corresponding month last year.

Federal Reserve Statement

The consolidated statement of the Federal Reserve banks for the week ended Jan. 17, showed decreases of $3,000,000 in holdings of discounted bills and of $1,000,000 in holdings of bills bought in the open market. Holdings of government securities remained unchanged.

Lycoming Has New Marine Reduction Gear

WILLIAMSPORT, PA. — Built-in reduction gears in four and eight-cylinder marine engines have been added to the Lycoming line. These engines are a part of the line being exhibited at the National Motor Boat Show in New York by the Lycoming Mfg. Co., a division of Cord Corp. The 1934 line includes three four-cylinder models, four Straight-Eights and a Twelve, with horsepower ranging from 35 to 325.

No Profit, Says Ket, In Over-Standardization

TORONTO—Speaking at the National Motor Show dinner of the Canadian Automobile Chamber of Commerce, Charles F. Kettering said: "The motor shows this year represent a breaking-away from old standardized processes. For the first time in years, visitors are able to distinguish the make of a car without looking at the name on the booth. Over-standardization brings stagnation, cut-throat competition and no profit. We should give the manufacturers credit this year for getting out of a rut and breaking away from standardization."

Speaking of present opportunities for business and increasing activities, Mr. Kettering declared he understood that General Motors of Canada was now passing travelers' expense accounts without calling a directors' meeting.

The chairman of the dinner was D. R. Grossman, vice-president of the Studebaker Corp. of Canada, and those present included the executive heads of all the automobile manufacturing companies in the Dominion.

Car Buyers Place Dependability First

DETROIT — The most extensive commercial poll ever undertaken in the United States shows that Dependability ranks at the top of the ten qualities which Americans desire most in their motor cars. This is disclosed in the first announcement of the results of the questionnaire sent during 1933 to a million and a half motorists by the Customer Research Staff of General Motors.

The Customer Research Staff announced that analysis of the more than 200,000 replies to the questionnaire shows that preference as to motor car characteristics are in the following order:

1st, Dependability; 2nd, Operating Economy; 3rd, Safety; 4th, Appearance; 5th, Comfort; 6th, Ease of Control; 7th, Smoothness; 8th, Low List Price; 9th, Pick-up; 10th, Speed.

Engineering Council Names Fred Feiker

WASHINGTON — Frederick M. Feiker has been appointed executive secretary of American Engineering Council, a position for 13 years held by Lawrence W. Wallace, who has resigned to become vice-president of the W. S. Lee Engineering Corporation. Mr. Feiker was formerly director of the Bureau of Foreign and Domestic Commerce of the Department of Commerce. During the past six months Mr. Feiker has been in charge of an inquiry into the needs and methods of developing trained men for the textile industry, in cooperation with the textile engineering departments of our Northern and Southern educational institutions, under an educational grant from the Textile Foundation.

McMullan Metallurgist for Timken-Detroit

DETROIT—O. W. McMullan has been appointed chief metallurgist of Timken-Detroit Axle Company. He has been formerly in charge of metallurgical research at Timken.

Auto-Lite To Absorb Moto-Meter Corp.

Directors to Ask Stockholders' Approval of Merger by Common Stock Transfer

TOLEDO—C. O. Miniger, president of The Electric Auto-Lite Company, Toledo, Ohio, and R. G. Martin, president of Moto-Meter Gauge & Equipment Corporation, Toledo, Ohio, announce that their respective Boards of Directors have approved the acquisition of Moto-Meter by Auto-Lite for approximately 300,000 shares of Auto-Lite common stock, subject to the approval of stockholders. The name of the consolidated company will be Auto-Lite Moto-Meter Corporation. Mr. Miniger is to be president of the consolidated company and Mr. Martin and D. H. Kelly are to be vice-presidents. The headquarters of the consolidated company will be in Toledo, where both companies have plants. The Moto-Meter plant in La-Crosse, Wis., will be continued as in the past, as will the Auto-Lite subsidiaries and affiliated companies at Niagara Falls, New York, Indianapolis, Oklahoma City, Oakland, California, Detroit and Port Huron, Cleveland, Columbus and Fostoria, Ohio and Toronto and Sarnia, Ontario.

The consolidation will give the company an extensive line of automotive electric equipment and it will also manufacture other parts for automobiles.

Mr. Miniger stated that one of the reasons for the consolidation was the rapid increase in volume of the business done by Moto-Meter, overtaxing its facilities, so that the consolidation should enable Moto-Meter to handle its very large increase in business without plant additions.

In addition to the manufacturing facilities which the consolidated company will have, it will have also approximately 30,000 retail outlets for their various products.

N.S.P.A. Membership Now Approximately 500

DETROIT—Following the annual series of mid-winter committee and Board meetings, National Standard Parts Association announces the election of twenty-eight new members, These were approved out of a total of thirty-eight applications which is the largest number considered by an N.S.P.A. membership committee within the past five years, according to E. P. Chalfant, executive vice-president. The addition of the new members' names brings the Association's roster close to the 500 mark.

Of the twenty-eight newly elected concerns, twenty-one are jobbers, one associate export jobber, two overseas associate jobbers, and four manufacturers. The new manufacturer members, together with the name of the individual in each organization who is acting as the company's representative in N.S.P.A. affairs, are: Andrew Brown Co., Los Angeles, Cal., Andrew Brown; Bunting Brass & Bronze Co., Toledo, O., E. N. Beisheim; Fostoria Pressed Steel Corp., Fostoria, O., C. D. Pifer; and Walker Manufacturing Co., Racine, Wis., G. R. Walker.

December Registrations 30% Ahead of 1932

PHILADELPHIA — New passenger car registrations for December amounted to approximately 59,500 as against 45,683 a year ago and 94,180 during November of this year, according to estimates based on returns from 33 states. This gives an indicated increase over December, 1932, of about 30 per cent but shows a decline from November of approximately 37 per cent.

On the basis of these partial returns Ford resumes his position in first place with 18,800 new registrations, Plymouth comes up to second place with 12,200, and Chevrolet drops to third place with 9,650 units. As compared with December, 1932, Ford shows an increase of about 53 per cent, Plymouth 20 per cent, and Chevrolet 10 per cent.

Based on actual returns for eleven months and this estimate for December, the total for the year should be approximately 1,495,000 new car registrations.

Goodrich Man Heads Div. Code Authority

NEW YORK—J. H. Connors, vice president and general manager of the mechanical goods division, B. F. Goodrich Company has been named chairman of divisional code authority for the mechanical rubber goods group, it is announced by A. L. Viles; president of The Rubber Manufacturers Association.

Others selected to serve with Mr. Connors include H. N. Young, Hamilton Rubber Mfg. Co., Trenton, N. J., C. D. Garretson, Electric Hose & Rubber Co., Wilmington, Del., A. L. Kress, deputy administrator of the National Recovery Administration and Mr. Viles.

Grossman Reelected President of Can. C. of C.

TORONTO—At the meeting of the Canadian Automobile Chamber of Commerce in Toronto during the National Motor Show, D. R. Grossman, vice-president and general manager of Studebaker Corp. of Canada, Limited, was reelected president of the organization which represents the passenger automobile manufacturers of the Dominion. This is Mr. Grossman's fourth successive term.

McQuay-Norris Adds Manufacturing Plant

Buys Six-Story Building Which Adds 25% to Production Capacity

CONNERSVILLE, IND.—Through the purchase of another building, 50,000 square feet of floor space has been added to the manufacturing plants of McQuay-Norris Manufacturing Company. The new building represents about a 25 per cent increase in floor space and will be a part of Plant No. 3 which it adjoins. The building is a six story brick structure with a complete power house and heating unit. It is equipped with a modern sprinkler system throughout.

The acquisition of this building became necessary through increased manufacturing operations growing out of greater production.

In Connersville McQuay - Norris maintains what is said to be the largest exclusive gray iron piston foundry in the world as well as complete piston, piston pin, bolt and bushing factories. Other plants of the company are located in St. Louis, Mo., Indianapolis, Ind., and Toronto, Ont., Canada, with complete factory branches at Philadelphia, Chicago, Oakland and Los Angeles.

Ingersoll to Make Gemmers in Canada

TORONTO—The Ingersoll Machine Company at Ingersoll, Ontario, has taken over the Canadian production of steering gears and other automotive products of the Gemmer Mfg. Company, whose Canadian patents have been acquired by the Ingersoll Company.

The Canadian firm has installed 85 machines for Gemmer production and an available factory adjacent to the Ingersoll plant has been secured to provide further facilities for extensive operations.

Buick Reports Increased Sales at N. Y. Show

DETROIT—W. F. Hufstader, general sales manager, Buick Motor Company, has reported that bona fide sales of Buick cars during Show week in New York totaled 260 units. This total which includes sales made in the metropolitan district of New York, is 32 per cent above the comparative figure of 1933.

"It is noteworthy," said Mr. Hufstader, "that our sales not only show a gratifying increase, but that 54 per cent of them were of the longer wheelbase cars in the 60 and 90 series, an indication that the higher price market is strengthening."

Progress in Marine Engine Design Demonstrated at Motor Boat Show

(*Continued from page 115*)

5 in., making the combined stroke 10 in. The engine is said to have a speed range of 600-1800 r.p.m. and a power range of 50-145 hp., and the specific weight is 13 lb. per hp.

Another new Diesel engine on exhibition is the Hill eight-cylinder V, the block of which can be cast either in iron or aluminum. The one at the Show has an aluminum block. It has 5 by 7 in. cylinders, develops 200 hp. at 1,650 r.p.m., and weighs (in aluminum) 2,400 lb. with reverse gear, making the specific weight 12 lb. per hp.

Buda shows a smaller size of its M.A.N. Diesel marine engines. It is of 186 cu. in. displacement and develops in excess of 40 hp. Fairbanks Morse & Co., show a number of new Diesels of both the two- and four-cycle types. A fairly large two-cycle engine is designed primarily for workboat use. It is air-starting and direct-reversing. The four-cycle engines, of which several different sizes are shown, are of recent development and are comparatively light in weight. They range in power output from 8 hp. up.

Prominent among the gasoline engine exhibitors is the Chrysler Corporation, which has added a new model, the Ace, a six-cylinder engine with a piston displacement of 201 cu. in. At the Chrysler stand engine mounting on rubber in shear is being featured, and a rubber-cushioned engine coupling is shown.

The Lycoming Manufacturing Co., among other models, again shows the twelve cylinder engine which was first exhibited at the motorboat show last year. On the stand of the Red Wing Motor Co. are shown two engines of different size which are started on gasoline and later operated on fuel oil which is injected mechanically. The writer understands that these engines are being manufactured under Waukesha license.

A reversing gear has always been an essential fitment of motorboat engines, except the smaller sizes; recently, with the increase in engine speeds, reducing gears are being used to a considerable extent. Several engines at the show are fitted with a reduction gear manufactured by the Morse Chain Company of Detroit. Lycoming has developed a special reduction gear for marine work during the past year.

Numerous meetings of industrial, technical, trade and sporting organizations in or connected with the motorboat field are being held here this week. The motorboat dinner of the S.A.E. was held on Tuesday night, while the annual meeting of the National Association of Engine and Boat Manufacturers takes place Friday.

M.E.M.A. Credit Service Open to All Manufacturers

NEW YORK—Operation of the Credit Department of the Motor and Equipment Manufacturers Association has been placed directly under the supervision and control of member credit executives through the establishment of a Credit Governing Board by the MEMA Board of Directors. The new board is headed by Ralph L. Smith of the Pyrene Manufacturing Co., and its full membership of 12 credit executives will be announced within the next week.

All details of operation and matters of policy will be determined by the Credit Governing Board and the department will be separate from other MEMA activities. Under the new set-up, as announced to members by Mason T. Rogers, President of the MEMA, membership on the Board will be rotated from year to year amongst credit executives affiliated with the service.

Services of the MEMA Credit Department, on an unlimited basis, will now be available to all manufacturers in the industry, regardless of membership in the Association. Rates are based on subscribers' annual sales volume and already have been announced to the industry. At the same time membership in the MEMA, including participation in all activities, will be available either with or without credit service. Rates for credit service to members also have been revised and announced. The department will remain in charge of Arthur H. Fagan, Credit Manager.

Engineers Discuss New Problems

(*Continued from page 91*)

Diesels by R. P. Lansing, of Eclipse Aviation Corp.

In addition to electing J. H. Hunt, Harold Nutt and F. F. Chandler members at large of the nominating committee, the business session was featured by the introduction of an amendment to the constitution. This amendment would empower the council by a three-quarter vote to change the initiation fee and dues schedules, and is intended to give the council power to meet any problems that may arise as a result of the government's monetary program.

Among the new things at the exhibition staged in conjunction with the meeting are the following: The American Chemical Paint Company's new granodine metal protection process, which after cleaning coats the metal with zinc-tri phosphate, a coating which is said to defy salt spray. Continental-Diamond Fibre Co. shows two brand-new testing machines, demonstrating the quietness and strength of Celoron-spoked gears. Waukesha has on display its new test engine of the compression-ignition type for testing Diesel fuels. Wilcox-Rich exhibits a new design of hydraulic valve lifter. Federal-Mogul reveals a new cadmium-base, thin-wall, steel-back bearing with extremely high melting point. It is said to have a high resistance to pounding. Trico shows a new muffler with venturi attachment designed to produce a positive source of vacuum for windshield wipers, etc. The device is patented and Trico is prepared to license its manufacture. Trico also has a pressure "fueler" fuel pump operating on the vacuum principle, to be used in conjunction with the venturi muffler equipment.

Ex-Cell-O Boosts Orders And Sells to Russia

DETROIT—Incoming orders booked by Ex-Cell-O Aircraft and Tool Corp. for the first half of January exceed orders for all January, 1933, by more than 50 per cent, according to N. A. Woodworth, president.

"Ex-Cell-O," said Mr. Woodworth, "has regained a valuable customer in the Soviet Government with which the company did a large business in past Russian buying programs, having recently sold them several diamond boring machines similar to those used by manufacturers in this country. The Soviet also has placed orders for special machinery and inquiries indicate a large market in the future."

Campbell May Try for Records on Salt Beds

SALT LAKE CITY—William F. Sturm of Indianapolis, American representative of Sir Malcolm Campbell, has informed the Salt Lake City Chamber of Commerce that Campbell, who is the present holder of the world's kilometer and mile automotive speed records, may make his next attempt to lower these records on the salt beds west of this city. It is understood that experiments will soon be made to determine whether the salt crust will support the 5-ton weight of Campbell's racing car.

Decision Withheld In Budd Case

(*Continued from page 114*)

the American Federation of Labor in the Philadelphia District, gave his version of the efforts of the employees to obtain from the company recognition of what they considered the right to organize. He said that it was not until the ground work of organization had been laid that the company came forward with its plan for a company union. He charged that there was intimidation of employees by the company in the organization of its employees' representatives plan.

E. G. Budd, president of the company, read a strong statement setting forth the company's position. He dealt with each of the issues specifically and in connection with the charge of interference with employees, he declared:

"We believe that there could be no better illustration of the type of interference which the statute condemns than that which has been continuously exercised for the past six months on our employees by the organizers and officers of the American Federation of Labor."

Replying to the charge of discrimination against members of the United Automobile Workers, the statement declared that the company both before and since the enactment of the N.I.R.A. has never, to its knowledge, discharged or discriminated against any man in its employ because of his membership in any labor union.

The statement pointedly said that the company has declined to comply with "recommendations or rulings" of the Philadelphia Regional Labor Board and the National Labor Board that it discharge a part of its present force and reinstate all the strikers, and that it repudiate the election of Sept. 7, and the company's agreement to deal with the representatives so elected.

The company detailed clearly its reasons for not yielding to the "decisions" of the Board and broadly took the position that the company's own organization representatives were properly elected for the purposes of collective bargaining.

It was pointed out that on Sept. 7, by the affirmative vote by secret ballot, 79 per cent of the entire number on the payroll designated from among their number certain fellow employees as the nominees from whom, at another election held later, they were to elect the representatives to speak for them in collective bargaining. At the second election, it was stated, by affirmative vote of 92 per cent of the whole number, they chose the 19 representatives whom the company recognized and with whom it has agreed to negotiate thereafter.

"There is not the slightest evidence of intimidation, or that the company knew or could have attempted to ascertain, how or for whom any employe voted," the statement said.

Brunner Manufacturing Elects Officers

UTICA, N. Y.—The Board of Directors of the Brunner Manufacturing Company has elected the following officers: L. J. Brunner, chairman of the board; G. L. Brunner, president and treasurer; M. H. Pendergast, vice-president and factory manager; W. C. Allen, vice-president and sales manager; A. G. Zumbrun, comptroller and B. J. Scholl, secretary.

The company has recently added to its products a line of single stage air compressors and has increased its sales staff 50 per cent to take advantage of improved business conditions.

Federal Truck Sales Show 51% Increase

DETROIT—Federal Motor Truck Company has reported that dealers' orders for 1933 showed an increase of approximately 51 per cent over those of the previous year. J. F. Bowman, vice-president in charge of sales, stated that since early in April of last year Federal has enjoyed one of the best sales periods in several years.

Chrysler Employes Benefit By Investment Plan

DETROIT — Chrysler Corporation has announced that employees who participated in the 1929 employees Savings and Investment Plan which matured on Dec. 31, 1933, will receive in Corporation stock and uninvested cash a return equivalent to about six to one on the amount of their deposits.

Plymouth Has Orders Amounting to $21,000,000

DETROIT—The Plymouth Motor Corp. has orders on hand for shipment for more than $21,000,000 worth of 1934 Plymouth models, H. G. Moock, general sales manager for Plymouth, announced at the Detroit Automobile Show yesterday.

Excuse, Please

Inadvertently, the cuts for Fig. 3 and Fig. 5 on pages 70 and 71 respectively, in last week's issue were interchanged. The group of three broaches in Fig. 3 are made by Thos. Prosser & Son, while the broach in Fig. 5 is the product of Ex-Cell-O.

Uptrend Noted in Orders for Steel

December Shipments Showed Increase—Price Rise Hinted

NEW YORK—Specifications coming to finishing mills from motor car manufacturers and parts makers are decidedly on the uptrend. The American Iron & Steel Institute's statistical report for the week, showing a decrease in the rate of steel mill operations from 34.2 per cent to 32.5 per cent of theoretical capacity is largely explained by the temporary suspension of one of its departments by a Youngstown district mill. Most of the finishing mills are operating at about the same rate as last week, with incoming business giving hope of a step up in operations next week.

More and more steel company executives now venture the prediction that before long their industry will be operating at between 50 and 60 per cent of capacity, and in this forecast automotive buying is once more assigned its classical role of the bell-wether in the more general buying movement that must develop to support this rate of activity.

Automotive buying is distributed over sheets, strip-steel, steel bars, alloy steels and bolts and nuts. Flat steel sales, output and shipments in December showed an increase of from 10 to 25 per cent over November, this improvement being in a large measure attributed to better takings by automotive consumers.

A statement by W. S. Tower, executive secretary of the American Iron & Steel Industry, that the cost of steel production under code operation has increased 70 per cent has made a deep impression on buyers and by many is accepted as presaging further price advances, moderate in extent and gradual as they are expected to be because of the well known policy of the larger steel producers to avoid, if possible, censure from consumers.

Pig Iron—Virtually all markets present a routine appearance, Code prices being firmly adhered to in all transactions, most of which are for single carloads that are ordered as needed by automotive foundries.

Aluminum—Middle West specialists in secondary aluminum report better automotive inquiries. Prices rule a shade firmer. Quotations for virgin metal are unchanged.

Copper—Code discussions continue to engage the market's principal attention, there still being decided differences of opinion between the large producers and custom smelters. The question of whether the Administration will sanction the inclusion of minimum prices in the Code is also far from definitely settled. Meanwhile the market has made slight gains, the week's opening price for electrolytic being 8⅜, delivered Connecticut Valley.

Tin—The market is fairly steady, fluctuations being almost entirely the result of the movement of Pound Sterling against the dollar. Spot Straits was quoted at the opening of the week at 51½c., gaining fractionally on Tuesday as the result of slightly higher rates of exchange.

Lead—Storage battery manufacturers are covering their February needs at unchanged price levels.

Zinc—Irregular, with Prime Western quoted at around 4¼c., East St. Louis.

Timken Engineering Handbook

A LOOSE-LEAF book of general information on Timken roller bearings has been issued by the Timken Roller Bearing Co., Canton, Ohio. It differs materially from previous editions in that new load ratings have been established, based on the fatigue life of the bearings. An explanation of these ratings, together with the method of calculating loads and selecting bearings, comprises one section. This is followed by a statistical presentation of the bearings available in the various types. These tables have been arranged uniformly by cone bore, with the smallest bores shown first. In the single-row group are included the standard or conventional bearings, the tapered-bore, steep-angle, keyway-cone, flanged-cup, S.A.E. Standard and airplane series. The two-row assemblies include the two-row self-contained bearings; the two-row, double-cone, single-cups, both in the wide and narrow series. In the same group will be found the tapered-bore cones, with and without pullers, and the slotted-cone bearing.

Next in order come the double-cup bearings, that is, the assemblies in which two standard cones are assembled into a double cup to form a unit, and the N.A. group. Both of these are divided into the regular and steep-angle series. Another tabulation appears here, covering a type of bearing very similar to the N.A. assemblies; the cone, however, consists of a single piece, the cups being held apart and the correct bearing set-up maintained through the use of a split spacer ring inserted between the cups. With this spacer in place the entire assembly becomes a complete unit.

The four-row group is covered by two tabulations, those with cone-spacer pilots and those without. The former is recommended for applications which require a loosely fitted cone on the shaft and the latter those with a tight fit.

Following the tabulations just indicated will be found the T-type or flat thrust bearings and the steering-gear-type bearings.

The next two hundred odd pages comprise the dimension-sheet section. The illustrations in this division are to scale and accurate to 0.01 in. This permits the draftsmen to use them to trace the bearing in the proper position on his drawing either in full or half size, as both sizes are given in the book.

Canadian Plant For General Tire

TORONTO — Announcement has been made by V. P. Reid of the General Tire and Rubber Company, Akron, Ohio, now in Toronto, of the organization of a Canadian branch company of the same name for the purpose of producing and marketing General Tire products for the Canadian and export fields.

An agreement has been made with the Seiberling Rubber Company of Canada Limited, Toronto, for the manufacture in Toronto of General Tires to the specifications of and under the supervision of the General Tire and Rubber Company of Akron.

A considerable proportion of the export business of the Akron plant will be diverted to the Toronto factory, according to Mr. Reid. Offices of the Canadian subsidiary have been opened in the Royal Bank Building, Toronto.

A.A.A. Presents Cup To Ab Jenkins

WASHINGTON — The Contest Board of the American Automobile Association, through Colonel Rickenbacker, chairman, has presented a special cup to Ab Jenkins in recognition of his having established sixty-six speed records in twenty-five and a half hours with his 12-cylinder Pierce-Arrow Special over the salt beds of Salduro, Utah last August.

A. C. Launches Campaign For Clean Spark Plugs

TOLEDO—A National Spark Plug Cleaning Campaign has been launched by the AC Spark Plug Co. with an elaborate program including meetings of dealers to be held throughout the country, newspaper and business paper advertising and radio broadcasting. The first of approximately 30 meetings to be held in the Eastern district within the next 10 days was held at the Waldorf-Astoria in New York on Monday of this week.

According to figures which will be presented at the meetings of the dealers, the automotive maintenance branch of the industry normally does a $1,500,000,000 business annually, or an amount approximately equal to the volume done through the sale of new cars and trucks. It will be pointed out that, as a consequence, the improvement of conditions in the service and maintenance end of the automotive business is of vital importance to general economic recovery. It is believed that getting car owners to go to service stations to have their spark plugs cleaned will result in the development of much additional business for the service man.

Bus Code Authority To Name Labor Boards

WASHINGTON — Following the methods and the example set by the National Labor Board, the Motor Bus Code Authority, with the approval of the Code Administrator, has decided upon the immediate establishment of regional industrial relations boards to pass upon and make recommendations with reference to all complaints between employers and employees so far as they may come under the provisions of the code.

There will be eleven such regional boards constituted geographically the same as the divisions for which the members of the board of directors of the association are elected under the by-laws of the National Association of Motor Bus Operators. Each board will be composed of three employers and three employee members.

CALENDAR OF COMING EVENTS

AUTOMOBILE SHOWS

Detroit, Mich.	Jan. 20-27
Hartford, Conn.	Jan. 20-27
Baltimore, Md.	Jan. 20-27
Boston, Mass.	Jan. 20-27
San Francisco, Calif.	Jan. 20-27
Pittsburgh, Pa.	Jan. 20-27
Montreal, Canada	Jan. 20-27
Rochester, N. Y.	Jan. 22-27
Harrisburg, Penna.	Jan. 24-27
Chicago	Jan. 27-Feb. 3
Washington, D. C.	Jan. 27-Feb. 3
Indianapolis	Feb. 3-9
St. Paul	Feb. 3-10
Toledo, Ohio	Feb. 3-9
Camden, N. J.	Feb. 3-10
Los Angeles	Feb. 3-11
Omaha, Neb.	Feb. 5-9
Lansing, Mich.	Feb. 7-10
Rapid City, S. D.	Feb. 7-10
Springfield, Ill.	Feb. 8-10
Kansas City, Mo.	Feb. 10-17
Syracuse, N. Y.	Feb. 10-17
Black Hills, S. D.	Feb. 15-17
Des Moines, Ia.	Feb. 19-24
Evansville, Ind.	Feb. 20-24
Denver, Colo	Feb. 20-28
Peoria, Ill.	Feb. 21-25

OTHER SHOWS

Road Show, Chicago	Jan. 22-27

CONVENTION AND SHOW

Natl. Assoc. of Engine and Boat Mfrs., New York City	Jan. 19-27

CONVENTIONS

American Road Builders' Association, Chicago	Jan. 22-27

MEETINGS

S.A.E. Annual Meeting, Detroit	Jan. 22-26
National Automobile Dealers Assoc., Chicago	Jan. 29
American Institute of Mining & Met. Engineers, New York City	Feb. 19-22
U. S. Chamber of Commerce, Washington	May 1-4